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INSTRUCTION MANUAL
FOR THE
UNIVERTER
TYPE 207H

BOONTON RADIO COMPANY

Green Pond Road Rockaway, New Jersey

U.S.A.

1M/CP/9-66

00207-90007

Printed in U.S.A.

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TABLE OF CONTENTS

Section *Page*

I. DESCRIPTION

General 7
Operating Controls and Layout 7

II. SPECIFICATIONS 7

III. OPERATING INSTRUCTIONS

Installation 8
Preliminary Instructions 8
Using the Univerter 9
Output Connections 9

IV. THEORY OF OPERATION

General 10
Oscillator 11
Mixer 11
Broad-band Amplifier 11
Attenuator 11
Power Supply 11

V. OPERATIONAL GUIDE

Introduction 11
Frequency Drift 11
X.01 (40 db) Output Jack 11

VI. MAINTENANCE

General 12
Preventative Maintenance 12
Trouble Shooting and Repair 12
Mechanical Disassembly Procedures 12
Adjustment and Calibration 14

VII. REPLACEMENT PARTS

List of Manufacturers 16
Table of Replaceable Electrical Parts 16
Table of Replaceable Mechanical Parts 19

LIST OF ILLUSTRATIONS

Figure No.	*Title*	*Page*
1.	Operating Controls and Layout	6
2.	207H Dimensions	8
3.	Rack Mounting Instructions	9
4.	Signal Source Representation	9
5.	Output Circuit of 207H with 501B Output Cable Attached	10
6.	Equivalent Output Circuit of 207H with 501B Output Cable Attached	10
7.	505B T-Pad (Attenuator) Circuit	10
8.	505B T-Pad (Attenuator) Equivalent Circuit	10
9.	Functional Block Diagram—207H	10
10.	Mixer Circuitry	11
11.	Attenuation Network	11
12.	Typical Drift—207H Internal Oscillator	12
13.	Gear Replacement	14
14.	Oscillator Frequency Adjustment	15
15.	Bandpass Adjustment	15
16.	207H Bandpass	15
17.	Low Frequency Bandpass Check	16
18.	207H—Top View	20
19.	207H—Bottom View	20
20.	207H RF Chassis—Bottom View	21
21.	207H Front Panel Mechanical Parts	22
22.	Schematic—207H	23

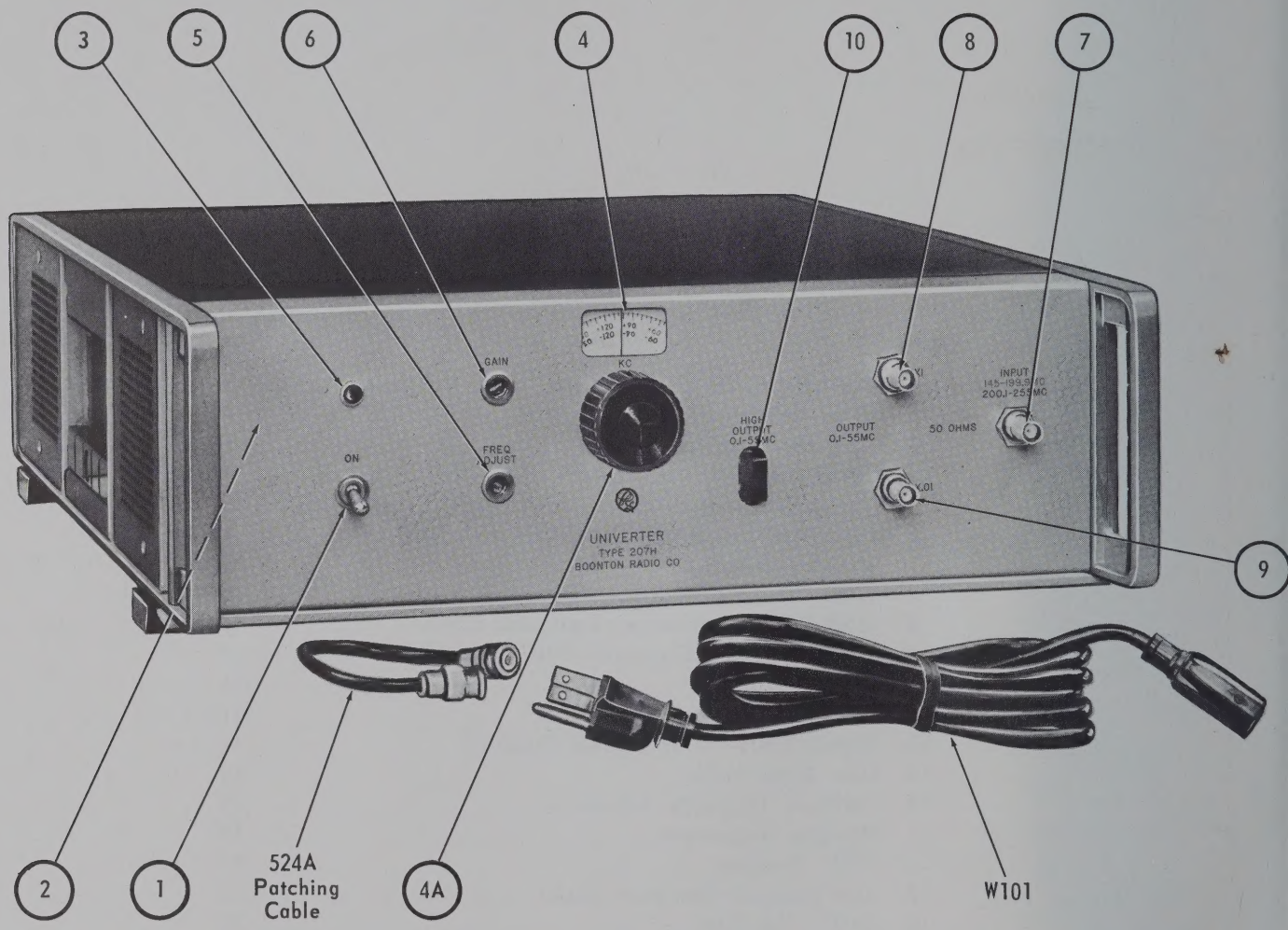


Figure 1. Operating Controls and Layout

1. Power Switch
2. Fuse (On Rear Panel)
3. Pilot Light
4. Frequency Increment Dial
4A. Frequency Increment Control
5. Frequency Adjustment
6. Gain Adjustment
7. Input Jack
8. Unity Gain Output Jack (XI)
9. Attenuated Output Jack (X.01)
10. Uncalibrated Output Jack (High Output)—With Plug

SECTION I
DESCRIPTION

GENERAL

The Type 207H Univerter, a frequency converter with unity gain, is designed for use with the Type 202H FM-AM Signal Generator and the Type 202J Telemetering Signal Generator to provide additional frequency coverage from 100 kc to 55 mc, including commonly used intermediate frequencies.

The Univerter consists essentially of a semi-fixed frequency, 200 mc heterodyne oscillator; a wide band amplifier; and a self-contained regulated power supply. In operation, the internal heterodyne oscillator beats with the output signal of the 202H (199.9 to 145 mc) or 202J (200.1 to 255 mc) and the difference frequency is passed through the wide band amplifier to the output system.

Three separate outputs are provided: X1, X.01, and a high-level output. The X1 output provides unity gain, under the control of the signal generator attenuator, and is suited for most general purpose applications. The X.01 output attenuates the input signal level as well as the random noise power output by 40 db and is specifically provided for receiver measurements in the low microvolt region. The uncalibrated, high-level output provides a minimum of 1 volt with 0.1 volt input.

The Univerter operates from a power source of 95-130 volts, 60 cps (207H) or 95-130/190-260 volts, 50 cps (207HP). The instrument is housed in a modular cabinet which may be stacked with a 202H or 202J Signal Generator or, by use of the mounting brackets furnished, may be readily adapted for standard 19 inch rack mounting.

OPERATING CONTROLS AND LAYOUT

A front view of the instrument with all of its controls is shown in Fig. 1. All of the controls for operation of the 207H are located on the front panel. Instrument front panel designations are shown within quotation marks.

1. Power Switch "ON"

This switch applies power to the circuits when in the "ON" position.

2. Fuse

This fuse in the ac line is located on the back panel of the instrument. (1.5 amp for 95-130v input, .75 amp for 190-260v input).

3. Pilot Light

4. Frequency Increment Dial "KC"

The Frequency Increment Dial is used to tune the 200 mc internal oscillator over a limited range. This dial is calibrated in 5 kc increments from —300 kc to +300 kc.

4A. Frequency Increment Control

The Frequency Increment Control operates the Frequency Increment Dial (4).

5. Frequency Adjustment "FREQ ADJUST"

The Frequency Adjustment is a front panel screwdriver adjustment used to zero the Frequency Increment Dial with the Signal Generator dial at the center frequency of the Univerter oscillator. The range of this control is approximately 4 mc.

6. Gain Adjustment "GAIN"

The Gain Adjustment is a front panel screwdriver adjustment used to set the gain of the Univerter so its output is correctly indicated by the signal generator attenuator dial.

7. Input Jack "Input—145-199.9 MC 200.1-255 MC"

This BNC type connector is used to connect the 207H Univerter to the output of the 202H or 202J Signal Generator.

8. Unity Gain Output Jack "X1–50 OHMS".

This BNC type connector makes the Univerter output available for use. By properly setting the GAIN adjustment (6), this output is directly read on the Signal Generator attenuator dial.

9. Attenuated Output Jack "X.01—50 OHMS".

This BNC type connector makes the Univerter attenuated output available for use. By properly setting the GAIN adjustment (6), this output is 40 db below the reading indicated on the Signal Generator attenuator dial.

10. Uncalibrated Output Jack "HIGH OUTPUT—0.1-55 MC".

This 2 pin connector makes the amplified output of the Univerter available for use. A gain of 10 + results in greater than 1 volt output with 0.1 volt input to the Univerter. The output impedance of this jack is nominally 300 ohms.

SECTION II
SPECIFICATIONS

Radio Frequency Characteristics

RF RANGE: 100 KC to 55 MC
with 199.9 to 145 MC Input from 202H
with 200.1 to 255 MC Input from 202J

RF CALIBRATION:
Incremental Range: ± 300 KC
Incremental Calibration: Increments of 5 KC
Incremental Accuracy: ± (3% + 1 KC)

RF STABILITY:
Short Term: <0.001%* (5 minutes)
Long Term: <0.005%* (1 hour)
Line Voltage: <400 cps/volt
*after one hour warmup

RF OUTPUT:
Range:
(A) 1μv to 0.1 volts* (X1)
(B) 0.01μv to 1mv* (X.01)
(C) >1 volt** (HIGH OUTPUT)
*across external 50-ohm load at panel jack
**with 0.1 volt input and 300 ohm output load

Accuracy:
(A) Reproduces output of 202H or 202J ± 1db
(B) Reproduces output of 202H or 202J ± 2 db

Impedance: (A) 50 ohm nominal
(B) 50 ohm nominal
(C) 300 ohm nominal

Spurious Output: All spurious output voltages are better than 25 db* below desired output. Spurious output of 207H alone consists of random noise and 200 MC local oscillator. At X. 01 output, noise power essentially equivalent to 50-ohm resistor at room temperature.

*for input levels <0.05 volts

Modulation Characteristics

RANGE:

Duplicates FM and AM modulation of 202H or 202J

DISTORTION:

FM: No appreciable distortion
AM: No appreciable distortion for input levels <0.05 volts

Accessories

FURNISHED:

Type 524A Patching Cable
High Output Plug

AVAILABLE:

Type 501B Output Cable
Type 502B Patching Cable
Type 506B Patching Cable
Type 514B Output Cable

Tube Complement

1—6AF4A	1—6ER5
2—6AK5	1—6688

Physical Characteristics

MOUNTING:

Cabinet for bench use; readily adaptable for 19" rack mounting

FINISH:

Gray engraved panel; green cabinet (Other finishes available on special order)

DIMENSIONS:

See Figure 2.

WEIGHT:

Net:	26 lbs. (11.7 kg.)
Gross Dom.:	38 lbs. (17kg.)
Gross Exp.:	68 lbs. (30.6 kg.)
Legal Exp.:	43 lbs. (19.5 kg.)

Power Requirements

207H: 95-130 volts, 60 cps, 50 watts

207HP: 95-130/190-260 volts, 50 cps, 50 watts

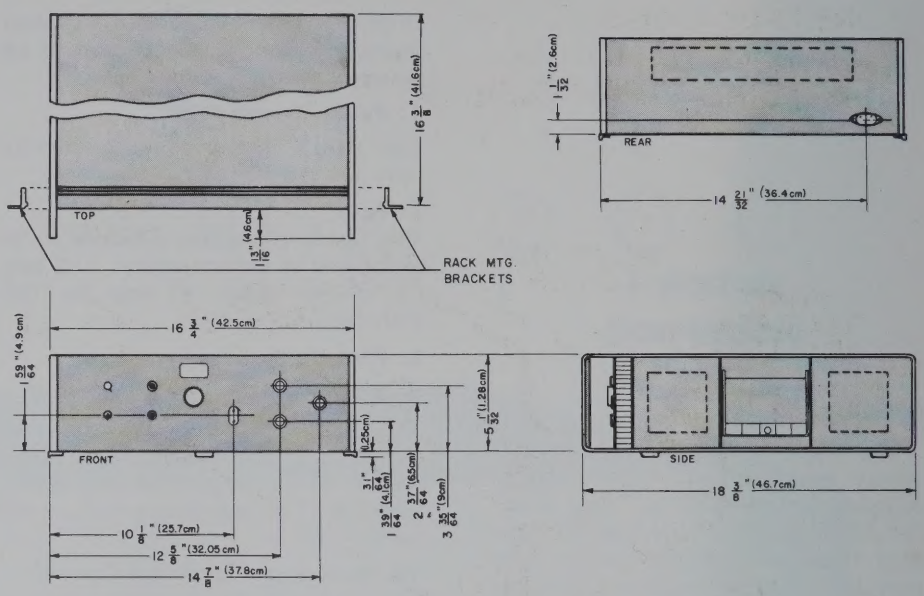


Figure 2. 207H Dimensions

SECTION III
OPERATING INSTRUCTIONS

INSTALLATION

Remove the Type 207H Univerter from its shipping carton and place it in position on a test bench.

Using it with either the 202H or 202J Signal Generators, the 207H Univerter may be stacked under the Signal Generator. This arrangement will not only be convenient for interconnection of units but it will also minimize frequency instability by having the cooler unit (the 207H) on the bottom. By use of the accessory hardware furnished with the Univerter (see Fig. 3), it can be rack mounted under the Signal Generator.

Connect the type 524A Patching Cable between the Univerter Input Jack (7) and the Signal Generator output jack.

Connect the power cord to the power socket on the rear of the 207H. Then connect the power cord to a 95-130 V, 60 cycle source. On the type 207HP, which is the 50 cycle model, an input voltage switch is located on the power supply chassis and may be operated to use the 207H with either a 95 to 130 volt or 190 to 260 volt source.

NOTE: Reverse voltage plate on the back panel to agree with switch and change fuse as described under Operating Controls and Layout.

Set the power switch to the "ON" position and allow unit to warm up a minimum of 1 hour for stabilized output frequency. (Refer to Signal Generator Instruction Manual for Signal Generator "warm-up" time.)

PRELIMINARY INSTRUCTIONS

Front Panel Frequency Adjustment

After sufficient "warmup" of the Univerter and the Signal Generator, connect earphones or a sensitive ac VTVM to the Univerter HIGH OUT-

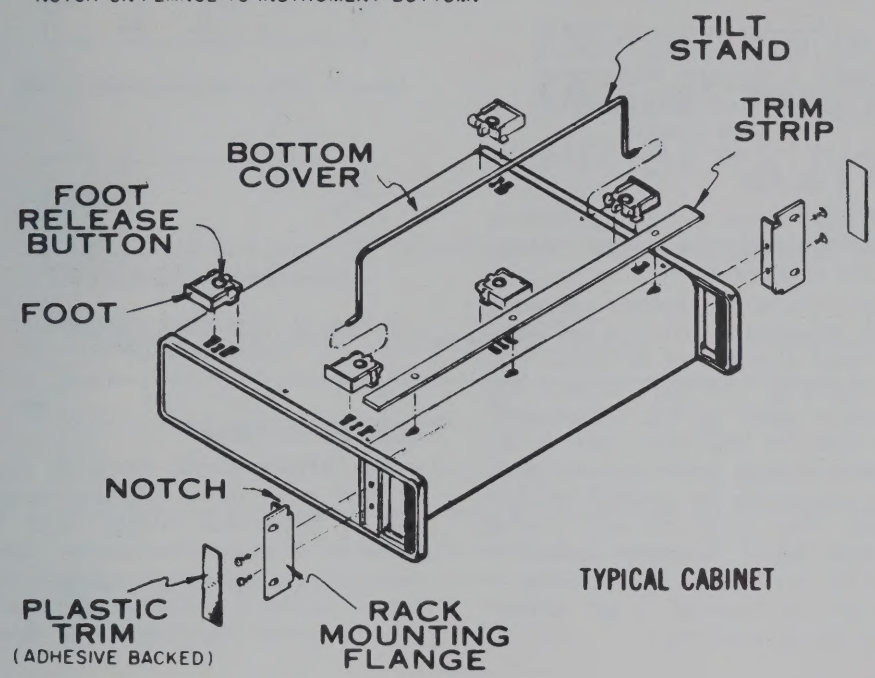


Figure 3. Rack Mounting Instructions

PUT jack. Set frequency of the Signal Generator, 202H or 202J, to precisely 200 mc (Univerter center frequency), and the Univerter Frequency Increment Dial (4) to "0". Adjust the Frequency Adjustment (5) for zero beat or null. This operation will correlate the Frequency Increment dial on the Univerter with the Frequency dial on the Signal Generator. During normal operation of the Univerter, this adjustment should be checked occasionally.

Front Panel Gain Adjustment

Disconnect the Signal Generator from the Univerter. With the Signal Generator properly terminated, set the output level of 100 k μv or -7 dbm using a Signal Generator Calibrator (such as the BRC Type 245), or a power meter (such as the -hp- 431). Reconnect the Univerter and the Signal Generator. Set the Univerter Frequency Increment Dial (4) to +200 kc or -200 kc. With the Univerter properly terminated, check the output voltage at the Unity Gain Output Jack (8) using an accurate VTVM (such as the -hp- 400H). If reading is not 100 k μv as supplied by the Signal Generator, adjust the Gain Adjustment (6) to make it so. This operation will allow direct reading of the Univerter output from the Signal Generator attenuator dial. If the desired output frequency is greater than 10 mc, the 431A/B power meter may be used directly to compare the Univerter output with that of the Signal Generator, and to set the gain to unity.

USING THE UNIVERTER

In conjunction with either the 202H or 202J Signal Generator, the 207H Univerter will provide a continuous band of frequencies from 100 kc to 55 mc. The required input frequency band from the 202H is 199.9 to 145 mc. The required input frequency band from the 202J is 200.1 to 255 mc. The low limit frequency (100 kc) is useable only when unmodulated. When amplitude modulating, the lowest carrier frequency should be 100 kc plus the modulating frequency (f_{mod}). When frequency modulating, the lowest carrier frequency should be 100 kc plus the frequency deviation ($\triangle f$) plus the modulating frequency (f_{mod}).

The Input Jack (7) has two frequency ranges shown above it in red and black lettering. This color code corresponds to the color code on the Frequency Increment Dial (4). Thus, when using a frequency within the red coded band, the red numbers on the dial (4) are used.

OUTPUT CONNECTIONS

For output requirements from 1000 μv to .1 volt, the X1 (8) Output Jack may be used. However, at levels below 1000 μv, the X.01 (9) Output Jack should be used. The noise level of the 207H is constant with signal input, thus, if a high level input signal is used and attenuated at the output, the noise level will also be attenuated 40 db in the case of the X.01 Output Jack. This improves the signal-to-noise ratio to the point where the X.01 jack noise power output is essentially that of normal thermal agitation noise in a 50-ohm resistor at room temperature.

The method of connecting the load to the 207H Univerter[1] must be considered to insure proper interpretation of results, and the following discussion is offered as an aid to the user. When the Front Panel Gain Adjustment is made, the driving signal generator attenuator reads the voltage "E" representing the Univerter loaded output (X1) in the following diagrams.

NOTE: Avoid erroneous readings by connecting to only one Univerter output at a time, since the pads are designed for any *one* output to be nominally terminated.

It is convenient to represent a signal source in terms of its open-circuit voltage and internal impedance. Thus, a signal source or an antenna can be represented as in Fig. 4. For simplicity, only the case where source and load impedance are resistive will be considered. This represents the output connections when the Type 502B cable is used.

For purposes of rating sensitivity, the input to a receiver might have been

[1]Connections to the Unity Gain Output Jack (X1).

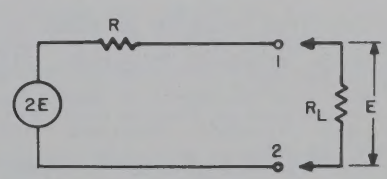


Figure 4. Signal Source Representation

defined initially either as the open-circuit source voltage 2E or the voltage actually across the receiver terminals. The Institute of Radio Engineers has established the former method as standard and defined receiver input in terms of the open-circuit votage of the source[2].

The impedance of the signal source employed to test receivers should be equal to the impedance of the antenna with which the receiver is designed to operate. Note that in this case the voltage actually across the receiver terminals is

$$\frac{2E}{2} = E$$ (Receiver input impedance equal to source impedance).

The Signal Generator attenuator is calibrated to read the voltage "E" of Figures 4 through 8.

Accessories for physically connecting the instrument to the load are described in the following:

502B Patching Cable

Provides simple connection for a matched load. (See Fig. 4.)

501B Patching Cable

The 501B Cable attached to the 207H is illustrated by Fig. 5, where R_2 is the 50-ohm termination of the 501B Cable.

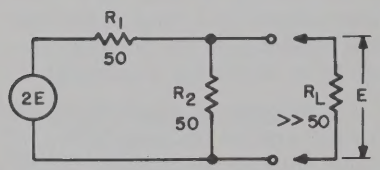


Figure 5. Output Circuit of 207H with 501B Output Cable attached

The equivalent circuit (Fig. 6) is readily determined by applying Thevinin's theorem. This arrangement is recommended for general use where it is desirable to connect the 207H output to an input circuit of much higher impedance than 50 ohms. The attenuator of the Signal Generator will read the open-circuit output directly.

[2]IRE STD 17.S1 Standards on Radio Receivers: Methods of Testing Frequency Modulation Broadcast Receivers, 1947. Adopted by ASA.

IRE STD 17.S1 Standards on Radio Receivers: Methods of Testing Amplitude-Modulation Broadcast Receivers, 1948. Adopted by ASA.

IRE STD 17.S1 Standards on Television: Methods of Testing Monochrome Television Broadcast Receivers, 1960. Adopted by ASA.

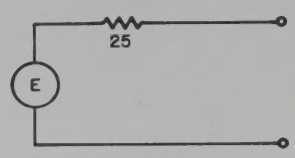


Figure 6. Equivalent Output Circuit of 207H with 501B Output Cable Attached

505B 6 db Pad

This pad is used as a dummy antenna in testing unbalanced receivers with a 50-ohm as shown in Fig. 7.

The open-circuit voltage appearing across terminals 1 and 2 is by Ohms law equal to E, half of the source voltage. Applying Thevinin's theorem, the equivalent circuit of Fig. 8 is obtained and thus the attenuator dial of the Signal Generator reads receiver sensitivity directly for the assumed standard output. This circuit is well matched and the Signal Generator attenuator reads the open-circuit source voltage as specified in footnote 2 for receiver sensitivity measurement.

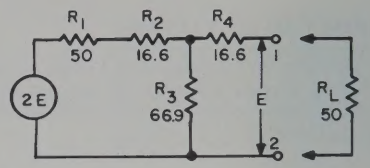


Figure 7. 505B T-Pad (Attenuator) Circuit

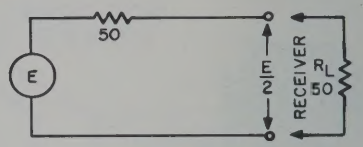


Figure 8. 505B T-Pad (Attenuator) Equivalent Circuit

509B 20 db T-Pad

The 509B pad, like the 505B, may be used as a dummy antenna, except that the open-circuit voltage, which is a measure of receiver sensitivity (equivalent source voltage), is one-fifth the Signal Generator attenuator dial reading. The source impedance is 50 ohms.

SECTION IV
THEORY OF OPERATION

GENERAL

The 207H Univerter is shown in block diagram form in Figure 9. This instrument is designed as a companion unit for use with the 202H FM-AM Signal Generator or the 202J Telemetering Signal Generator to increase the frequency coverage to include the 100 kc to 55 mc range.

The Univerter consists of a stable semi-fixed oscillator; a broad band mixer; a three-stage, unity gain broad band amplifier; and a self-contained regulated power supply.

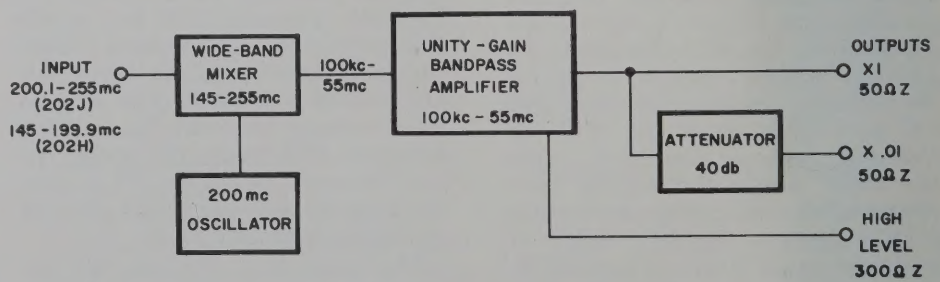


Figure 9. Functional Block Diagram—207H

MANUAL CHANGES

MODEL 207H Univerter
Manual Serial Prefixed: none
Manual Printed: 8-63, 9-66
HP Stock No. 00207-90007

To adapt this manual to instruments with other serial prefixes check for errata below, and make changes shown in tables.

Instrument Serial Prefix	Make Manual Changes
635, 646	1

Instrument Serial Prefix	Make Manual Changes

► New or revised item.

CHANGE No. 1

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. The -hp- 207H Univerter has been improved by changing the power supply to a new type, solid state, electronically regulated supply utilizing a printed circuit board assembly. The new power supply allows a line voltage choice of 105-125 v or 210-250 v and a line frequency variation of 50 to 1000 Hz. With this change the new improved 207H Univerter replaces the two models (207H and 207HP) formerly available.

1-3. The RF Unit and front panel mountings have been changed to improve the mechanical stability of the instrument and the part availability for instrument maintenance. A low-pass filter has been added to attenuate the output of the 200 MHz oscillator with its harmonics.

1-4. With the exception of reference to power requirements; under "General", last paragraph, first sentence; information in Section I of the Instruction Manual for the 207H Univerter (8-63) applies to the improved instruments.

1-5. Complete specifications for the 207H Univerter are shown in Table 1-1. Changes in the specifications as a result of the improvements in paragraphs 1-2 and 1-3 are indicated by Δ.

1-6. The information in Table 1-1 replaces the information in Section II of the Instruction Manual for the 207H Univerter (8-63).

1-7. With the exception of reference to the power requirements; under "Installation", fourth paragraph; information in Section III of the Instruction Manual for the 207H Univerter (8-63) applies to the improved instrument.

1-8. With the exception of the paragraph under, "Power Supply"; information in Section IV of the Instruction Manual for the 207H Univerter (8-63) applies to the improved instrument.

a. Delete information under "Power Supply" and add the following information.

"The Power Supply consists of two regulated supplies having a common power transformer. The output voltages are 168 vdc for the tube plate supply and 6.3 vdc for the tube filaments. A block diagram for the power supply is shown in Figure 1-1."

1-9. The information in Section V of the Instruction Manual for the 207H Univerter (8-63) applies to the improved instrument.

RF output accuracy: reproduces output of 202H or 202J ±1 db on 1 μv to 0.1 v range; ±2 db on 0.01 μv to 1 mv range.

RF output impedance: 50 ohms nominal on 1 μv to 0.1 v and 0.01 μv to 1 mv ranges; 300 ohms nominal at >1 v.

Spurious output: In-band spurious output voltages are better than 25 db below desired output for input levels < 0.05 v. Spurious output of 207H alone consists of random noise and 200 MHz local oscillator and harmonics. At X .01 output, noise power is essentially equivalent to 50-ohm resistor at room temperature.

Modulation range: duplicates FM and AM modulation of 202H or 202J.

Modulation distortion: FM, no appreciable distortion; AM, no appreciable distortion for input level < 0.05 v.

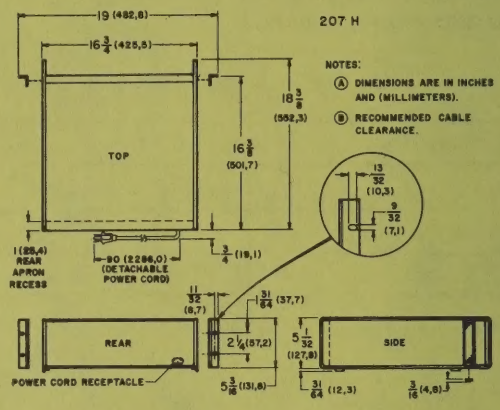
RF range: 100 kHz to 55 MHz (with 199.9 to 145 MHz input from 202H or with 200.1 to 255 MHz input from 202J.)

RF calibration: incremental range: ±300 kHz; incremental calibration: increments of 5 kHz; incremental accuracy; ± (3% + 1 kHz).

RF stability: short term (5 minutes): < 0.001%; long term (1 hour): <0.005%; after 1 hour warm-up; line voltage: <400 Hz/v.

RF output range: 1 μv to 0.1 v and 0.01 μv to 1 mv across external 50-ohm load at panel jack; >1 v with 0.1 v input and 300-ohm output load.

Dimensions:



Δ Weight: net 26 lbs. (11,7 kg); shipping 38 lbs. (17,1 kg).

Δ Power: 105 to 125 v or 210 to 250 v, 50 to 1000 Hz, 50 w.

Table 1-1. Specifications

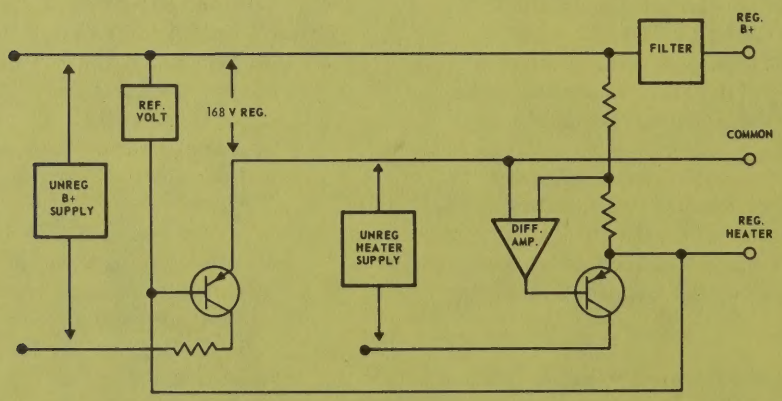


Figure 1-1 Power Supply - 207H

1-10. The information in Section VI of the Instruction manual for the 207H Univerter (8-63) should be changed as indicated in the following list:

a. "Mechanical Disassembly Procedures" under front panel should be:

1. Remove top and bottom covers.
2. Remove both right side covers and front left side cover.
3. Remove adhesive-backed trim strips from right and left side frames to allow removal of flat head screws securing side frame to front panel.
4. Disassembly right side frame by removing screws securing the RF Unit support, power supply chassis, and rear panel.
5. Remove front panel knob.
6. Disengage front panel from left side frame.
7. At this point the front panel may be moved away from the rest of the unit but will be restricted only by the connecting wires.

b. "Mechanical Disassembly Procedures" under RF Chassis should be:

1. Remove front panel as shown under "Front Panel".
2. Remove two screws from the left side frame to RF Unit support.
3. Unsolder wires from the power supply and remove three connectors from the front panel. (See front panel connector removal).

c. "Mechanical Disassembly Procedures" add the following:

Front Panel Connector Removal (Fig. 1-2).

1. Loosen large nut (MP 4) securing the connector body to the front panel of the instrument.
2. Loosen crimp nut assembly (MP 3) at rear of connector body (MP 4) but do not twist as damage to coaxial cable could result.

   NOTE: "D"-shaped hole in front panel will not allow connector body to rotate.

3. Remove nut and washer (MP 5 and MP 4) from connector body (MP 1) and slide over cable away from front panel.
4. Slide connector body and crimp nut assembly (MP 1-3) out of front panel to disengage connector body from D-hole.
5. Hold crimp nut assembly (MP 3) securely and twist connector body off of crimp nut assembly.

   (a) Damage to the crimp nut assembly may be repaired by replacing cable assembly (W101-103) which includes MP 2 and MP 3.

   (b) The connector body (MP 1) and the center connector (MP 2) are individually replaceable items.

Ref No.	-hp- Stock No.	Description
MP1	1250-0102	Bulkhead Mount Connector Body
MP2	1250-0051	Center Contact (Female)
MP3	NFR	Crimp Nut Assembly (p/o W101-103)
MP4	2950-0054	Connector Body Mount Nut
MP5	2190-0068	Lockwasher for MP 4
W101	00207-60025	Cable Assembly including MP 3
W102	00207-60026	Cable Assembly including MP 3
W103	00207-60027	Cable Assembly including MP 3

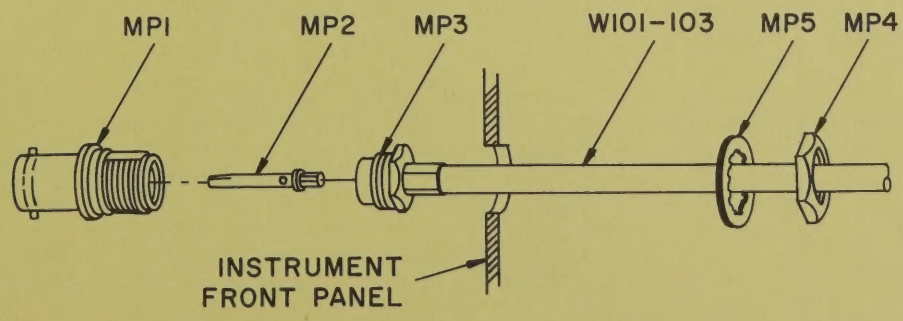


Fig. 1-2. Front Panel Connector Removal

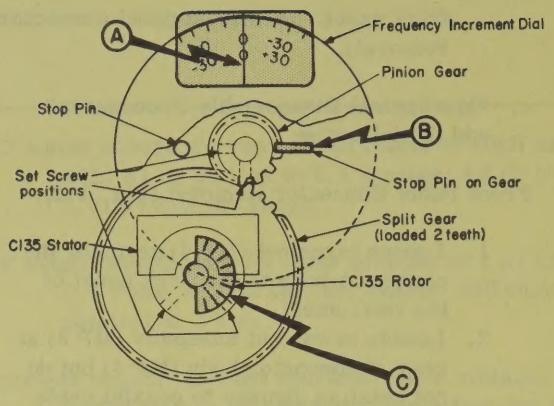


Fig. 1-3. Gear Replacement

d. "Mechanical Disassembly Procedures" add the following:

Gear Replacement

NOTE: The following procedure is to be used after the mechanical disasassembly of the frequency increment dial gear drive.

1. Install small gear on shaft and position gear stop pin as shown in Figure 1-3.
2. Rotate C135 rotor shaft until rotor in position shown in Figure 1-3 (mid-capacitance).
3. Slide split gear onto rotor shaft to engage one half of the split gear with pinion gear.
4. Holding pinion gear in place, rotate the free section of the split gear, with respect to the section held by the pinion gear, until the gear springs are just under tension. This is the point of zero load. Continue to rotate the free gear past zero load by two gear teeth to spring load the large split gear assembly.
5. Slide split gear in place to engage completely with the pinion gear. Setscrews should be in approximate position shown in Figure 1-3.
6. Install frequency increment dial and fiducial as shown in Figure 1-3. At this point the following conditions should prevail.

(A.) Frequency Increment Dial on "0" as indicated by fiducial line.
(B.) Stop pin on gear to be horizontal, pointing to the right. The stop can be checked by rotating dial to ends to assure equal spacing at each extremity.
(C.) C135 rotor should be at mid-capacitance.

e. Adjustment and Calibration under "Power Supply" should be:

Equipment Required

1. -hp- 400H ac VTVM or equivalent.
2. -hp- 412A dc VTVM or equivalent.
3. Variable Metered Power Source.

B+ SUPPLY CHECK

Preliminary Setup

Connect the 207H to the power source set to 115 vac. Connect the ac VTVM and the dc VTVM across the output filter capacitor (C302).

Check

1. Reading on the dc VTVM should be 168 ±12 v.
2. Reading on the ac VTVM should be less than .006 vac.
3. Change the power source to 105 v and note reading on dc VTVM.
4. Change power source to 125 v. Maximum swing of voltage reading should not exceed 2 vdc.

FILAMENT SUPPLY CHECK

With 105 to 125 v input to the 207H, the filament voltage should be 6.3 ±0.3 vdc.

SECTION II
REPLACEABLE PARTS

2-1. INTRODUCTION.

2-2. This section contains information for ordering replacement parts. Table 2-1 lists parts in alpha-numerical order of their reference designations and indicates the description and -hp- stock number of each part.

2-3. Miscellaneous mechanical parts are listed at the end of Table 2-1.

2-4. The information in this section is complete for the improved 207H Univerter.

2-5. In Table 2-1 the part numbers indicated by an asterisk (*) were not previously used on the 207H Univerter. In the case of indicated mechanical parts, these parts were changed from the original and are not directly replaceable.

2-6. For parts location see Figure 18 and Figure 20 in the Instruction Manual for the 207H Univerter (8-63) and Figure 3-1 of this supplement.

2-7. ORDERING INFORMATION.

2-8. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard sales and service office (see lists at rear of this manual). Identify parts by Hewlett-Packard stock number.

2-9. To obtain a part not listed, include:

a. Instrument model number
b. Instrument serial number
c. Description of part
d. Function and location of parts

Table 2-1. Reference Designation Index

Reference Designation	Stock No.	Description	Note
C101	0150-0050	C: fxd, cer, .001 μF, 600 vdcw	
C102		Not Used	
C103	0160-0468	C: fxd, cer, .02 μF, 600 vdcw	
C104	0121-0072	C: var, .5-30 pF, glass tubular	
C105	0150-0050	C: fxd, cer, .001 μF, 600 vdcw	
C106	0121-0072	C: var, .5-30 pF, glass tubular	
C107	0121-0072	C: var, .5-30 pF, glass tubular	
C108	0160-0168	C: fxd, paper, .1 μF, 200 vdcw	
C109	0160-0992	C: fxd, cer, .01 μF, 600 vdcw	
C110		Not Used	
C111	0160-0468	C: fxd, cer, .02 μF, 600 vdcw	
C112	0121-0078	C: var, 1-8 pF, glass tubular	
C113	0150-0050	C: fxd, cer, .001 μF, 600 vdcw	
C114	0121-0078	C: var, 1-8 pF, glass tubular	
C115	0121-0072	C: var, .5-30 pF, glass tubular	
C116	0160-0168	C: fxd, paper, .1 μF, 200 vdcw	
C117	0160-0992	C: fxd, cer, .01 μF, 600 vdcw	
C118		Not Used	
C119	0160-0468	C: fxd, cer, .02 μF, 600 vdcw	
C120	0121-0072	C: var, .5-30 pF, glass tubular	
C121		Not Used	
C122	0150-0050	C: fxd, cer, .001 μF, 600 vdcw	
C123, 124	0121-0072	C: var, .5-30 pF, glass tubular	
► ► C125	0170-0038	C: fxd, mylar, .22 μF, 200 vdcw	
C126	0160-0992	C: fxd, cer, .01 μF, 600 vdcw	
C127		Not Used	
C128	0160-0468	C: fxd, cer, .02 μF, 600 vdcw	
C129	0121-0078	C: var, 1-8 pF, glass tubular	
C130	0150-0050	C: fxd, cer, .001 μF, 600 vdcw	
C131	0121-0078	C: var, 1-8 pF, glass tubular	
C132, 133	0160-0488	C: fxd, cer, 10 pF, 2%, 500 vdcw	
C134	0160-0487	C: fxd, cer, 7.7 pF, 2%, 500 vdcw	
C135	List Below	C: var Parts Required 1 - 00202-60025 - Spring, Rotor Wiper 1 - 00207-00003 - Stator 1 - 00207-20008 - Bracket 3 - 00207-20013 - Spacers 1 - 00207-60016 - Rotor	
C136	0121-0072	C: var, .5-30 pF, glass tubular	
C137A, B	0121-0079	C: var, 1.5-3.1 pF	
C138	0160-0435	C: fxd, cer, 10 pF, 2%, 600 vdcw	
C139-143	0160-0345	C: fxd, ft, cer, .001 μF, 500 vdcw Mounting Hardware: Nut, hex, 12-32, -hp- Stock No. 0590-0060 Lockwasher, -hp- Stock No. 2190-0057	
C144A, B		Not Used	
C145A, B		Not Used	
C146A, B		Not Used	

Table 2-1. Reference Designation Index

Reference Designation	Stock No.	Description	Note
C147	0150-0050	C: fxd, cer, .001 μF, 600 vdcw	
C148, 149	0160-0491	C: fxd, cer, 47 pF, 10%, 600 vdcw	
* C150-151	0160-0181	C: fxd, cer, 30 pF, 10%, 200 vdcw	
* C300	0170-1748	C: fxd, elect, 45 μF, 250 vdcw	
* C301	0170-0040	C: fxd, my, .047 μF, 10%, 200 vdcw	
* C302	0180-1748	C: fxd, elect, 45 μF, 250 vdcw	
* C303	0180-0345	C: fxd, elect, 2000 μF, 25 vdcw	
* C304	0170-0024	C: fxd, my, .022 μF, 20%, 200 vdcw	
* C305	0140-0054	C: fxd, mica, 100 pF, 10%, 500 vdcw	
* C306	0150-0096	C: fxd, cer, 0.05 μF, 100 vdcw	
* CR300, 301	1901-0029	Diode, Si: 600 piv, 0.5 a	
* CR302, 303	1901-0409	Diode, Si: 50 piv, 3.0 a, 1N4719	
* CR304, 305	1901-0049	Diode, Si: 50 piv, 0.5 a	
* CR306	1902-0392	Diode, Si: 23.7 v, 5%, 1-1/2 w	
* DS201	1450-0048	Light, Indicator	
* F201	2110-0008	Fuse: cartridge 1/2 A 250 V (SLO-BLO) for 115 v operation	
* F201	2110-0018	Fuse: cartridge, 1/2 amp, (SLO-BLO) for 230 v operation	
► ► * F202	2110-0234	Fuse: cartridge, 3 AG, 1/10 A SLO BLO	
* J102, 103	1250-0102	Connector BNC: (X1, X .01) Less center conductor. See W101 and W102	(Refer to Fig. 1-2)
* J104	1200-0125	Socket, 2 pin (high output)	
* J105	1250-0102	Connector BNC: (INPUT) Less center conductor. See W103	(Refer to Fig. 1-2)
J201	1251-0148	Connector: AC Power Cord Receptacle	
L101	00207-80008	Choke, RF: 1.06 μH, 3%	
L102	00207-80007	Choke, RF: 2.9 μH, 3%	
L103	00207-80006	Choke, RF: .61 μH, 3%	
L104	00207-80005	Choke, RF: 1.71 μH, 3%	
L105	00207-80008	Choke, RF: 1.06 μH, 3%	
L106	00207-80007	Choke, RF: 2.9 μH, 3%	
L107	00207-80006	Choke, RF: .61 μH, 3%	
L108	00207-80005	Choke, RF: 1.71 μH, 3%	
L109	9140-0202	Coil, RF: .05 μH, 10%, 1 amp	
L110		Not Used	
L111	00207-80009	Choke, RF: 5 μH, 5%	
L112, 113		Not Used	
* L114	9100-1610	Coke, RF: .15 μH	
P104	1251-0416	Plug: High Output	
* Q300	1850-0098	Transistor: 2N458, PNP	
* Q301	1853-0016	Transistor: 2N3638, PNP	
* Q302	1853-0016	Transistor: 2N3638, PNP	
* Q303	1850-0098	Transistor: 2N458, PNP	
R101	0686-1015	R: fxd, comp, 100 ohm, 5%, 1/2 w	
R102	0686-4745	R: fxd, comp, 470K ohm, 5%, 1/2 w	
R103		Not Used	
R104	0689-2235	R: fxd, comp, 22K ohm, 5%, 1 w	
R105	0686-5115	R: fxd, comp, 510 ohm, 5%, 1/2 w	

Table 2-1. Reference Designation Index

Reference Designation	Stock No.	Description	Note
R106	0686-1045	R: fxd, comp, 100K ohm, 5%, 1/2 w	
R107	0686-1535	R: fxd, comp, 15K ohm, 5%, 1/2 w	
R108	0686-3305	R: fxd, comp, 33 ohm, 5%, 1/2 w	
R109	0686-6805	R: fxd, comp, 68 ohm, 5%, 1/2 w	
R110	0686-6835	R: fxd, comp, 68K ohm, 5%, 1/2 w	
R111	0686-1025	R: fxd, comp, 1K ohm, 5%, 1/2 w	
R112	0686-3315	R: fxd, comp, 330 ohm, 5%, 1/2 w	
R113	0686-1045	R: fxd, comp, 100K ohm, 5%, 1/2 w	
* R114	0686-1235	R: fxd, comp, 12K ohm, 5%, 1/2 w	
R115		Not Used	
R116	0686-6805	R: fxd, comp, 68 ohm, 5%, 1/2 w	
R117	2100-0821	R: var, ww, 400 ohm, 10%, 2 w	
R118		Not Used	
R119	0686-1025	R: fxd, comp, 1K ohm, 5%, 1/2 w	
R120	0686-5115	R: fxd, comp, 510 ohm, 5%, 1/2 w	
R121	0686-1045	R: fxd, comp, 100K ohm, 5%, 1/2 w	
R122	0686-6805	R: fxd, comp, 68 ohm, 5%, 1/2 w	
R123	0686-1535	R: fxd, comp, 15K ohm, 5%, 1/2 w	
R124	0686-1025	R: fxd, comp, 1K ohm, 5%, 1/2 w	
R125	0686-3315	R: fxd, comp, 330 ohm, 5%, 1/2 w	
R126	0686-3335	R: fxd, comp, 33K ohm, 5%, 1/2 w	
R127	0686-1035	R: fxd, comp, 10K ohm, 5%, 1/2 w	
R128	2100-1419	R: var, comp, lin, 1K ohm, 10%, 2.2 w	
R129		Not Used	
R130	0764-0003	R: fxd, met flm, 3.3K ohm, 5%, 2 w	
R131	0686-1505	R: fxd, comp, 15 ohm, 5%, 1/2 w	
R132, 133	0727-0948	R: fxd, car. flm, 10 ohm, 1%, 1/2 w	
R134	0727-0872	R: fxd, car. flm, 110 ohm, 1%, 1/2 w	
R135	0727-0948	R: fxd, car. flm, 10 ohm, 1%, 1/2 w	
R136	0727-0949	R: fxd, car. flm, 68.1 ohm, 1%, 1/2 w	
R137	0727-0423	R: fxd, car. flm, 39.2 ohm, 1%, 1/2 w	
R138	0727-0948	R: fxd, car. flm, 10 ohm, 1%, 1/2 w	
* R201	0686-6835	R: fxd, comp, 68K ohm, 5%, 1/2 w	
* R300	0686-1015	R: fxd, comp, 100 ohm, 5%, 1/2 w	
* R301	0686-7535	R: fxd, comp, 75K ohm, 5%, 1/2 w	
* R302	0692-1015	R: fxd, comp, 100 ohm, 5%, 2 w	
* R303	0686-6815	R: fxd, comp, 680 ohm, 5%, 1/2 w	
* R304	0686-4725	R: fxd, comp, 4.7K ohm, 5%, 1/2 w	
* R305	0686-2225	R: fxd, comp, 2.2K ohm, 5%, 1/2 w	
* R306	2100-0154	R: var, 1K ohm, 30%, 0.15 w	
* R307	0686-3315	R: fxd, comp, 330 ohm, 5%, 1/2 w	
* R308	0686-6825	R: fxd, comp, 6.8K ohm, 5%, 1/2 w	
* R309	0686-1215	R: fxd, comp, 120 ohm, 5%, 1/2 w	
* R310	0686-4745	R: fxd, comp, 470K ohm, 5%, 1/2 w	
* S201	3101-0001	Switch, Power: SPST Toggle	

Table 2-1. Reference Designation Index

Reference Designation	Stock No.	Description	Note
* S202	3101-0033	Switch, Slide: DPDT (Input Voltage Switch)	
* T201	9100-0402	Transformer, Power	
V101	1921-0021	Tube, Electron: 6ER5	
V102	1923-0055	Tube, Electron: 6AK5	
V103	1923-0041	Tube, Electron: 6688	
V104	1923-0055	Tube, Electron: 6AK5	
V105	1921-0034	Tube, Electron: 6DZ4	
* V300	1940-0004	Tube, Electron: OA2	
* W101	00207-60025	Cable Assy: to J103 (not including 1250-0102)	
* W102	00207-60026	Cable Assy: to J102 (not including 1250-0102)	
* W103	00207-60027	Cable Assy: from J105 (not including 1250-0102)	
* W104	00207-60028	Cable Assy: RF unit to Attenuator	
W201	8120-0078	Power Cord	
* Z300	00207-60024	Printed Circuit Board (with components)	
		Mechanical Parts	
	0370-0038	Knob	
	0590-0053	Nut, Clip (retains top and bottom covers)	
	1200-0019	Socket: 9 pin ceramic, V103	
	1200-0053 *	Socket, 7 pin: V300	
	1200-0044 *	Socket, Transistor Q300, Q303 (Use 1200-0081 Insulated Washers)	
	1200-0130	Socket, 7 pin minature: V101, V102, V104, and V105	
	1220-0043	Shield, Tube: V102, V104, and V105	
	1220-0044	Shield, Tube: V101	
	1220-0048	Shield, Tube: V103	
	1400-0084	Fuse Holder	
	1490-0030	Stand, Tilt	
	2950-0054	Nut, Plain Hex: 1/2-28 x 5/8 for 00207-20004	
	5000-0051	Strip, Trim: Adhesive backed	
	5000-0738	Cover, Side: rear	
	5000-0739	Cover, Side: Front	
	5040-0164	Strip, Large Filler (front bottom of instrument)	
	5060-0732	Frame, Side	
	5060-0740	Cover, Top	
	5060-0752	Cover, Bottom	
	5060-0763	Side Handle, Assembly	
	5060-0766	Retainer, Side Handle	
	5060-0767	Foot Assembly	
	5060-0775	Rack Mount Kit	
	00202-60025	Rotor Wiper Spring Assembly (p/o C135)	
	00207-00001	Cover, Bottom: RF Unit	
	00207-00003	Plate, Stator (p/o C135)	
	00207-00006	Panel, Front	
	00207-00032	Fiducial, Plate	
	00207-00033 *	Panel, Rear	

Table 2-1. Reference Designation Index

Reference Designation	Stock No.	Description	Note
	00207-20001	Fiducial	
	00207-20004	Bushing: Front Panel Trim	
	00207-20007	Housing, Rotor Shaft	
	00207-20008	Bracket, Rotor Wiper (p/o C135)	
	00207-20009	Shaft, Frequency	
	00207-20013	Spacer, Tapped: Round Stator (00207-00003) Mounting (p/o C135)	
	00207-20014	Shield, High Output Socket: Phenolic	
	00207-20022 *	Printed Circuit Board (less components)	
	00207-60001	Dial Assembly: Frequency	
	00207-60006	Gear Assembly: Large Split	
	00207-60008	Gear Drive Assembly	
	00207-60012	Attenuator Cover	
	00207-60016	Capacitor Rotor Assembly (p/o C135)	

SECTION III
MAINTENANCE DATA

3-1. INTRODUCTION.

3-2. This section provides the electrical circuit details in the form of a schematic, diagrams, typical voltage and resistancr readings, for maintenance of the 207H.

3-3. The Printed Circuit Board Z300 diagram in Figure 3-1 shows all of the circuitry on both sides of the board with all of the electrical components. This diagram will provide the following facilities:

a. Printed Circuit Board circuit tracing.
b. Component replacement of polarized devices such as semi-conductors, electrolytic capacitors, etc.

3-4. The voltage and resistance chart of Table 3-1 is a list of typical voltages and resistances at the tube sockets of the 207H Univerter.

3-5. Table 3-1 notes

a. Voltages were measured with an -hp- 412A dc VTVM with line voltage at 115 vac.
b. Resistances were measured with an -hp- 412A with power removed.
c. *Indicates measurement is not significant as semi-conductors and/or electrolytic capacitors are in the circuit.
d. Δ Reading varies with control setting.
e. (X) Measured at junction of C142 and R130 as probe connection at Pin No. 6 distrubs the circuitry.

3-6. The Voltage Chart of Table 3-2 is a list of typical voltage readings at the transistor elements.

3-7. Table 3-2 Notes

a. Voltages were measured with an -hp- 412A dc VTVM with line voltage at 115 vac.

3-8. **SCHEMATIC**

3-9. A complete schematic for the improved 207H Univerter is shown in Figure 3-2.

3-10. Schematic Notes

a. Resistance in ohms and capacitance in microfarads unless otherwise specified.
b. ▭ front panel designation.
c. ○— Front panel control
d. ◐ Screwdriver adjustment
e. (02) Numbers indicate wire color using RETMA Resistor Color Code, e. g. black-red is 02.
f. ▭ Printed Circuit Board Assembly

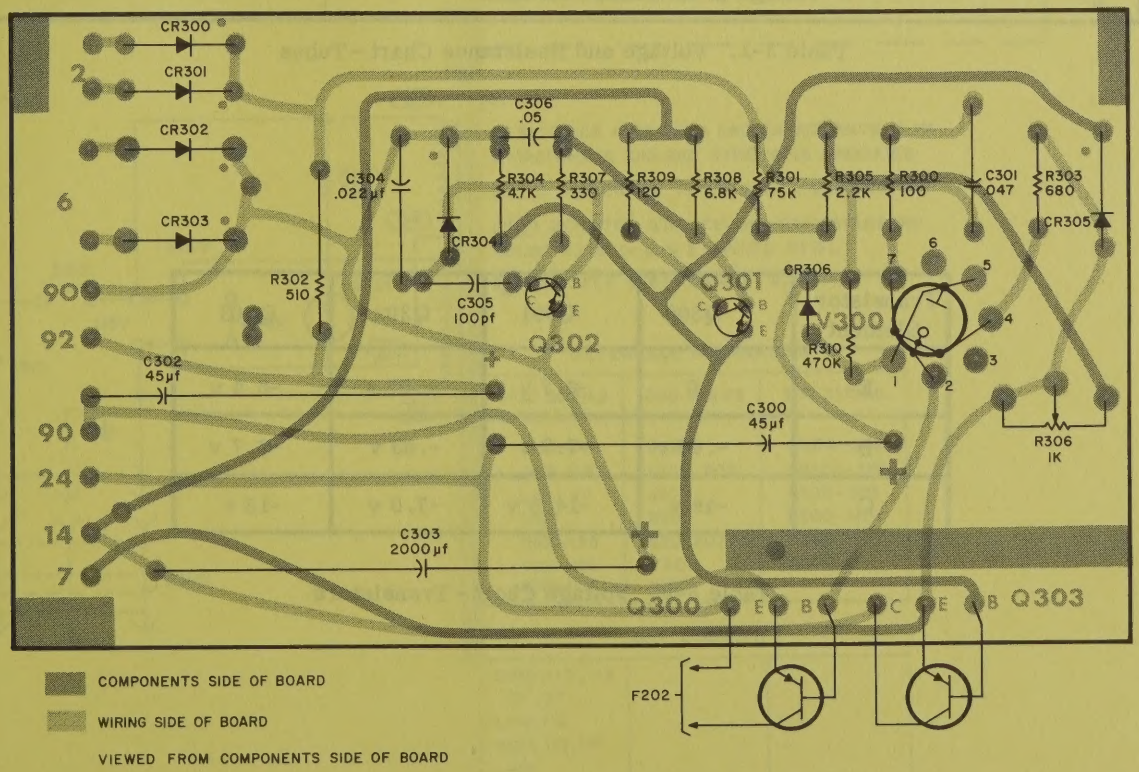


Fig. 3-1. Printed Circuit Board - Power Supply

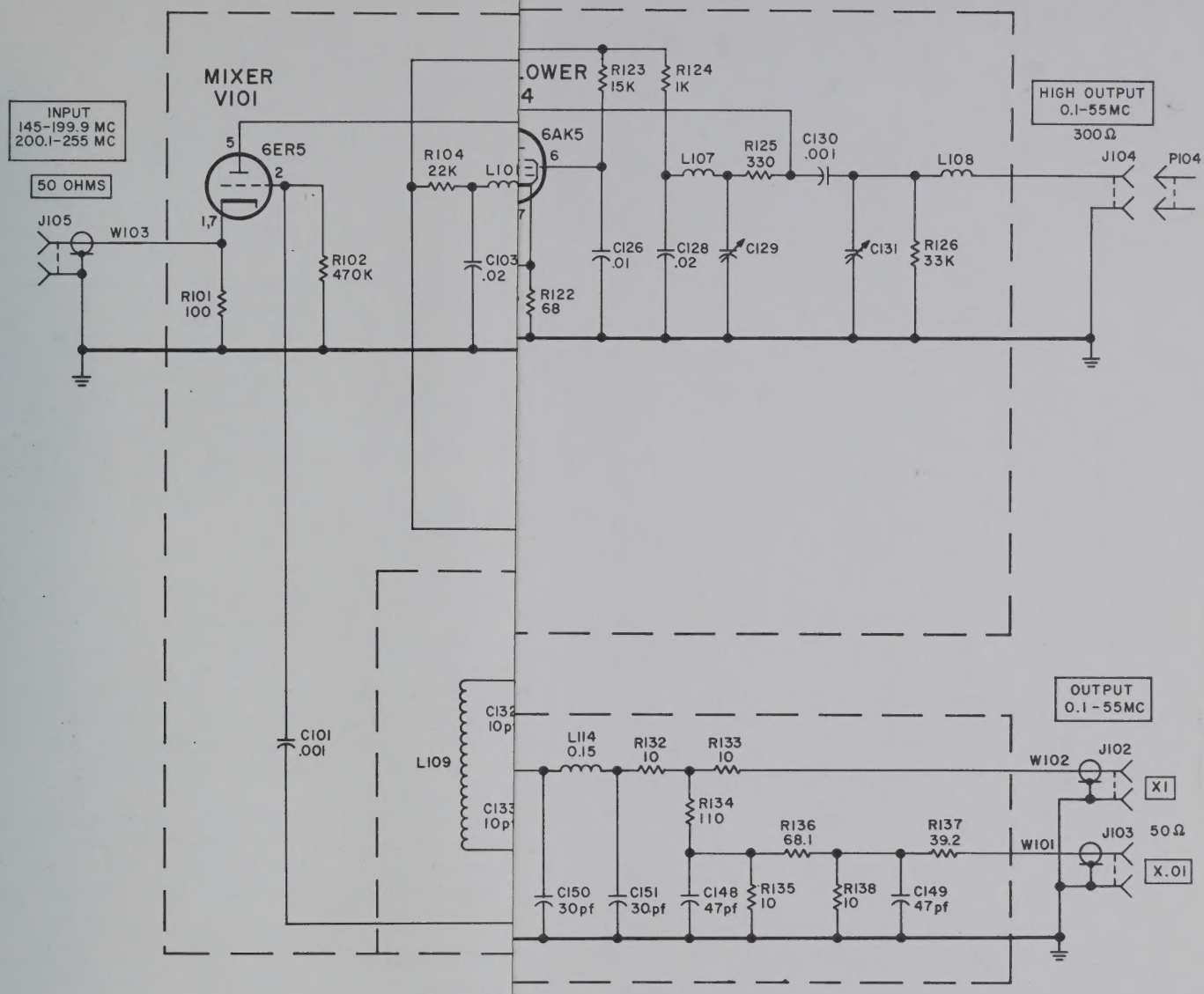
Pin No.	Type of Measurement	V101	V102	V103	V104	V105	V300
1	Voltage Resistance	.26 v 100Ω	0 100KΩ	Δ1.5 v Δ150Ω	0 100KΩ	100 v #	150 v #
2	Voltage Resistance	-1.9 v 500KΩ	Δ2.6 v Δ500	0 100KΩ	NC -	NC -	0 600Ω
3	Voltage Resistance	0 0	-6.3 v .75	Δ1.5 v Δ150Ω	-6.3 v .75Ω	-6.3 v .75Ω	9 v
4	Voltage Resistance	-6.3 v .75Ω	0 0	-6.3 v .75Ω	0 0	0 0	0 600Ω
5	Voltage Resistance	105 v #	160 v #	0 0	150 v #	.3 v 15Ω	150 v #
6	Voltage Resistance	0 0	120 v #	NC -	115 v #	X106 v 10KΩ	NC -
7	Voltage Resistance	26 v 100Ω	Δ2.6 v Δ500	155 v #	1.0 v 70Ω	NC -	0 600Ω
8	Voltage Resistance	- -	- -	0 0	- -	- -	- -
9	Voltage Resistance	- -	- -	135 v #	- -	- -	- -

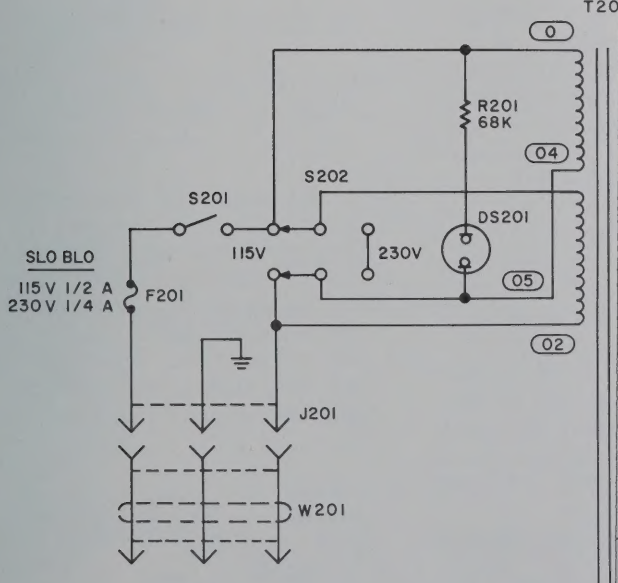
B+ Voltage at PC Board - 168 vdc
Heater Voltage at PC Board - -6.3 vdc
Voltage at B+ Fuse - -50 v

Table 3-1. Voltage and Resistance Chart - Tubes

Transistor Element	Q300	Q301	Q302	Q303
E	0	-6.7 v	+.02 v	-6.4 v
B	-.06 v	-7.3 v	-.63 v	-6.7 v
C	-48 v	-14.5 v	-7.0 v	-15 v

Table 3-2. Voltage Chart - Transistors





ES:

RESISTANCE IS IN OHMS AND CAPACITANCE IS IN MICROFARADS UNLESS OTHERWISE SPECIFIED.

▭ INDICATES FRONT PANEL DESIGNATION.

(9-2) DENOTES WIRE COLOR USING STANDARD COLOR CODE (e.g. 9-2 = WHITE RED).

⊘ DENOTES SCREWDRIVER ADJUST.

REFERENCE DESIGNATORS

100 SERIES	200 SERIES	300 SERIES
C101-151	DS201	C300-306
J102-105	F201-202	CR300-306
L101-114	J201	Q300-303
P104	R201	R300-310
R101-138	S201,202	V300
V101-105	T201	Z300
W101-104	W201	

NOT ASSIGNED

C102, 110, 118 121, 127 L110, 112 R103, 115, 118 129		

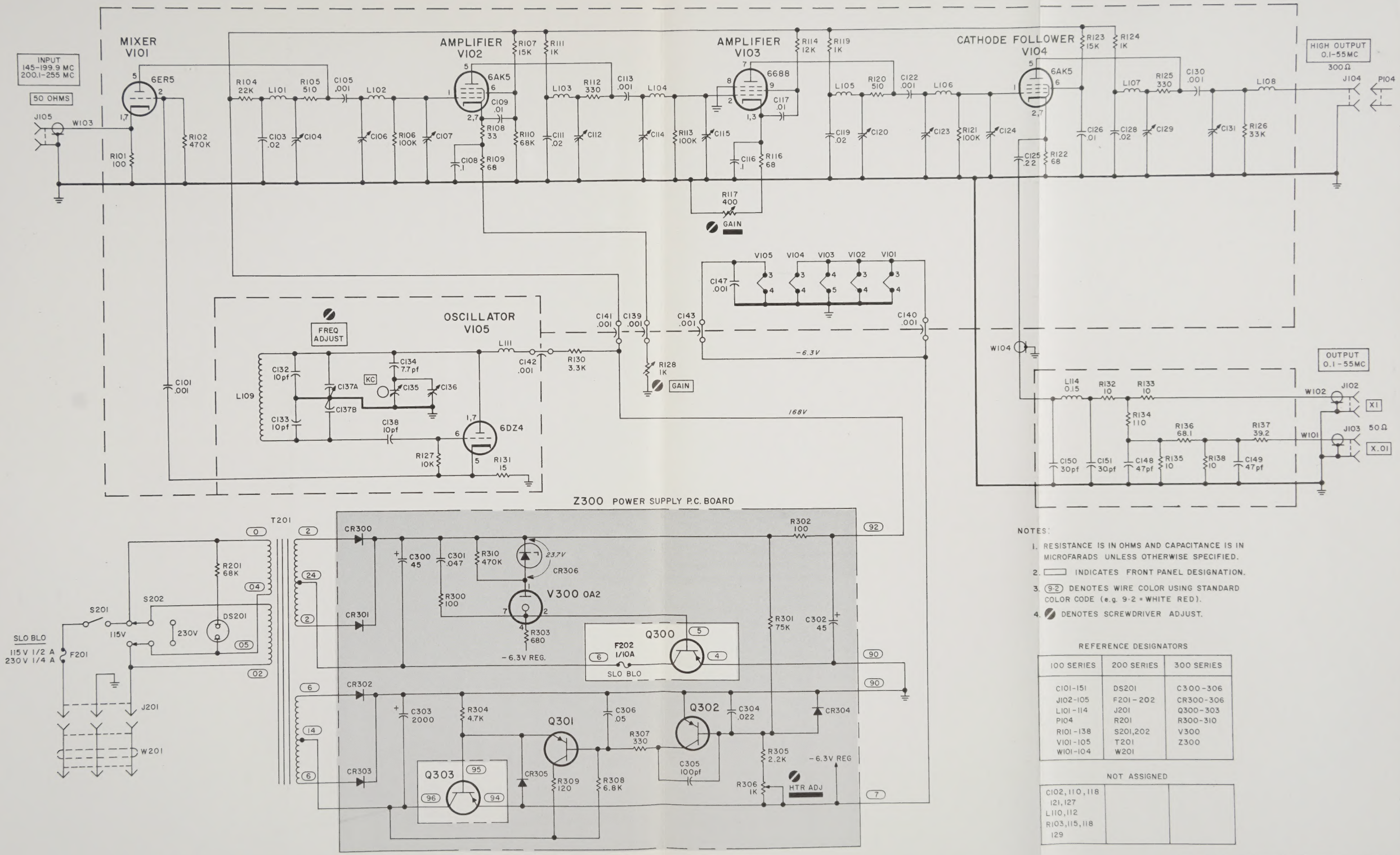
Figure 3-2. Schematic Diagram - 207H

Pin No.	Type of Measurement	V101	V102	V103	V104	V105	V300
1	Voltage Resistance	.26 v 100Ω	0 100KΩ	Δ1.5 v Δ150Ω	0 100KΩ	100 v #	150 v #
2	Voltage Resistance	-1.9 v 500KΩ	Δ2.6 v Δ500	0 100KΩ	NC -	NC -	0 600Ω
3	Voltage Resistance	0 0	-6.3 v .75	Δ1.5 v Δ150Ω	-6.3 v .75Ω	-6.3 v .75Ω	9 v
4	Voltage Resistance	-6.3 v .75Ω	0 0	-6.3 v .75Ω	0 0	0 0	0 600Ω
5	Voltage Resistance	105 v #	160 v #	0 0	150 v #	.3 v 15Ω	150 v #
6	Voltage Resistance	0 0	120 v #	NC -	115 v #	X106 v 10KΩ	NC -
7	Voltage Resistance	26 v 100Ω	Δ2.6 v Δ500	155 v #	1.0 v 70Ω	NC -	0 600Ω
8	Voltage Resistance	- -	- -	0 0	- -	- -	- -
9	Voltage Resistance	- -	- -	135 v #	- -	- -	- -
B+ Voltage at PC Board - 168 vdc Heater Voltage at PC Board - -6.3 vdc Voltage at B+ Fuse - -50 v							

Table 3-1. Voltage and Resistance Chart - Tubes

Transistor Element	Q300	Q301	Q302	Q303
E	0	-6.7 v	+.02 v	-6.4 v
B	-.06 v	-7.3 v	-.63 v	-6.7 v
C	-48 v	-14.5 v	-7.0 v	-15 v

Table 3-2. Voltage Chart - Transistors



NOTES:

1. RESISTANCE IS IN OHMS AND CAPACITANCE IS IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
2. ▭ INDICATES FRONT PANEL DESIGNATION.
3. (9-2) DENOTES WIRE COLOR USING STANDARD COLOR CODE (e.g. 9-2 = WHITE RED).
4. ⊘ DENOTES SCREWDRIVER ADJUST.

REFERENCE DESIGNATORS

100 SERIES	200 SERIES	300 SERIES
C101-151	DS201	C300-306
J102-105	F201-202	CR300-306
L101-114	J201	Q300-303
P104	R201	R300-310
R101-138	S201,202	V300
V101-105	T201	Z300
W101-104	W201	

NOT ASSIGNED

C102, 110, 118 121, 127 L110, 112 R103, 115, 118 129		

Figure 3-2. Schematic Diagram - 207H

OSCILLATOR

The 207H utilizes a 6AF4A UHF triode (V105) in a modified Colpitts oscillator circuit. Use of a metalized glass coil (L109) in the oscillator tuning circuit plus temperature compensation provides high stability.

The center frequency of the oscillator is nominally 200 mc. A front panel screwdriver adjustment, "FREQ ADJUST (5)", is a dual trimmer in the oscillator tuning circuit and can be used to shift the center frequency through a 4 mc range for calibration purposes. The front panel "Frequency Increment (4A)" control will swing the center frequency through a ± 300 kc range.

MIXER

A wide band mixer (V101) is used in the 207H in order to pass signals resulting from input frequencies 55 mc above to 55 mc below the 200 mc center frequency of the local oscillator. A flat input response (± .25 db over the 145 to 255 mc range) is accomplished by use of nonresonant coupling to both inputs of the mixer.

The external input to the mixer from a Type 202 Signal Generator is connected directly to the cathode of the mixer. The impedance of this input as seen by the 202 is:

$$Z_{in} = \frac{R_k}{1 + g_m R_k} = \frac{100}{1 + (.01)(100)}$$

= 50 ohms. When R_k = 100Ω and g_m = .01 mho

This is the proper loading for the 202 Signal Generators in order to make the attenuator read directly.

The above calculation does not account for inter-electrode capacity and assumes grounded-grid operation. However, those effects are small. The essentially grounded-grid operation can be seen in Fig. 10. The oscillator coupling network R131 and C101 is effectively shunting the mixer grid load resistor R102 with a dynamic resistance

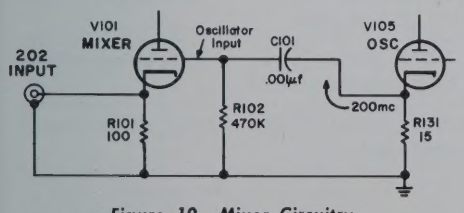


Figure 10. Mixer Circuitry

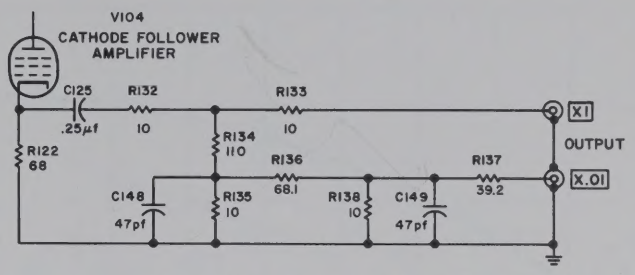


Figure 11. Attenuation Network

of less than 15 ohms (at 200 mc). A low-pass filter couples the mixer to the subsequent amplifier stages.

ATTENUATOR

Fig. 11 shows the attenuation network between the cathode follower/amplifier (V104) and the output jacks, X1 and X.01. The network to the X1 (Unity Gain) output jack has 3.5 db of attenuation for good low VSWR. Between the X1 (Unity Gain) output jack and X.01 (attenuated) output jack there is 40 db of attenuation.

Note that the jack in use should be terminated in 50 ohms but the unused one should be open circuited. This is especially important when using the X.01 output. The high output jack should be open circuited for best results.

BROAD-BAND AMPLIFIER

A two-stage, low-pass filter coupled amplifier is used to restore the insertion loss of the mixer and output pad as well as to maintain overall unity gain. A third stage, cathode follower/amplifier (V104), converts the high output impedance of the preceding stage to the required 50 ohms when using the Unity Gain (X1) or Attenuated (X.01) outputs. The cathode follower/amplifier, when used as an amplifier, has approximately a 23 db gain to the 300-ohm uncalibrated output.

The overall gain of the 207H can be adjusted by controls in the cathode circuits of the first two amplifiers. One control in cathode of V102 is a front panel adustment which can be readily checked and adjusted during use.

POWER SUPPLY

The power supply is a conventional voltage doubler type with a constant voltage transformer. The regulation of ± 1% is maintained by the stabilizing transformer.

SECTION V
OPERATIONAL GUIDE

INTRODUCTION

The Operational Guide is a section devoted to expanding the specifications of the 207H. This added information should assist in providing more accurate results as the capabilities and limitations of the Univerter are expanded upon.

FREQUENCY DRIFT

The specified frequency stability of the 207H Univerter is .005% or less per hour. This stability can be obtained after a one-hour warm-up period, under stable ambient temperature conditions. Typical long term drift data is shown in Fig. 12. It should be noted that this specification refers only to the drift of the local oscillator in the 207H. The specific combined drift during useage will be dependent on the 207H and the companion 202 Signal Generator.

X.01 (40 db) OUTPUT JACK

A broad-band mixer is an inherently noisy device when used preceding a wide-band amplifier. The 207H has a noise figure of approximately 25 db, which is equivalent to a noise output of eight microvolts, open circuit, over a 1 mc bandwidth at the Unity Gain Output Jack (X1). This noise power output is constant as the signal generator attenuator is varied. By use of a higher level input and the attenuated Output Jack (X.01), the signal to noise ratio can be improved 40 db, making low-level sensitivity measurements possible.

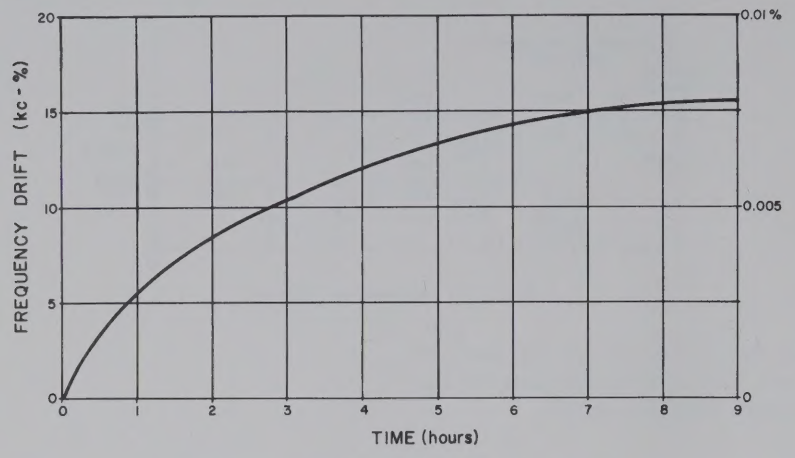


Figure 12. Typical Drift—207H Internal Oscillator

SECTION VI
MAINTENANCE

GENERAL

The 207H is a straight forward instrument which consists of an RF chassis and a power supply. Removal of the top and bottom covers, plus the bottom cover of the RF chassis, allows access to all parts for maintenance and repair.

PREVENTATIVE MAINTENANCE

Ventilation

The 207H contains electron tubes and thus requires a free flow of air through the unit to avoid overheating tubes and the components associated with them. The cabinet is adequately ventilated and requires no blower for cooling purposes. However, operating the instrument with the vents blocked will not only shorten tube and component life, but will require a longer warm-up time for frequency stabilization.

Lubrication

The 207H is adequately lubricated for the life of the instrument. The only necessity for added lubricant is to replace the lubricants wiped off during replacement of parts. To lubricate shafts, gears, bushings, etc., it is recommended that Beacon No. 325, Manufactured by Humble Oil and Refining Company, be used.

TROUBLE SHOOTING AND REPAIR

Tube Replacement Guide

The Tube Replacement Guide is primarily a checklist to show the tube functions with the readjustments required after tube replacement. The "Symptoms Noted" information, like the Signal Tracing Chart, is included as an organized starting point in the event that the instrument is not performing properly.

To gain access to all the tubes, the top cover only will have to be removed.

Signal Tracing Chart

The 207H consists of an oscillator, a mixer, and amplifiers, and thereby lends itself to the signal tracing method of trouble shooting. Using a 200.2 mc or 199.8 mc, unmodulated, 100 Kμv, input signal from a 202H/J Signal Generator; a point-to-point check of the 207H can be made using an ac VTVM such as the -hp- 400H and a frequency counter such as the -hp- 5243L with the -hp- 5253A frequency converter. This chart should be used with the Schematic (Fig. 22) and the Voltage and Resistance Chart.

Voltage and Resistance Chart

The Voltage and Resistance Chart indicates normal operating conditions for the 207H with no external equipment attached. Voltages were checked with a VTVM (-hp- 410A). Resistance readings were made under the same conditions with the power disconnected. Some resistance readings were omitted as they have no significance; i.e., cases where electrolytic capacitors are connected in the circuit.

MECHANICAL DISASSEMBLY PROCEDURES

Top and Bottom Covers

1. Remove four screws in each cover.
2. Slide cover toward rear of instrument to disengage rear foldover of cover.

Right and Left Side Covers

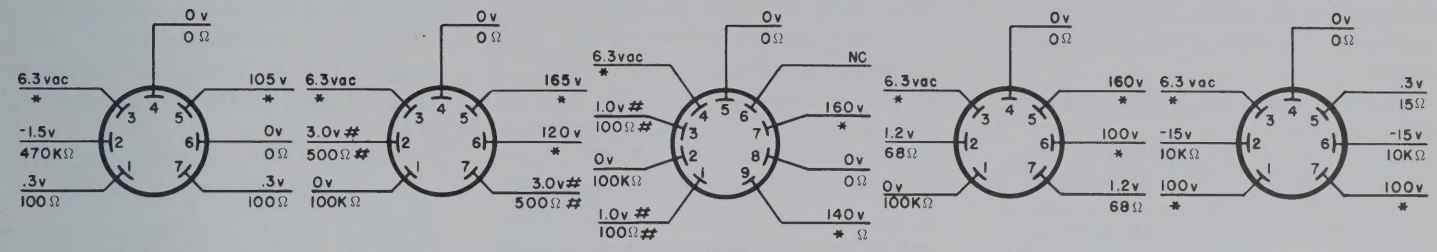
There are two covers on each side of the instrument. Each cover is held in place with two screws which may be removed without removing the top or bottom cover.

Front Panel

1. Remove top and bottom covers.
2. Remove both right side covers and front left side cover.

TUBE REPLACEMENT GUIDE

Ref. Sym.	Type	Application	Readjustment Req.	Symptoms Noted
V101	6ER5	Mixer	C104, C106, C107, and gain	Weak or no output
V102	6AK5	Amplifier	C104, C106, C107, C112, C114, C115 and gain	Weak or no output
V103	6688	Amplifier	C112, C114, C115, C120, C123, C124, and gain	Weak or no output
V104	6AK5	Cathode Fol. Amplifier	C120, C123, C124, C129, C131, and gain	Weak or no output
V105	6AF4A	Oscillator	C136	No output Off frequency

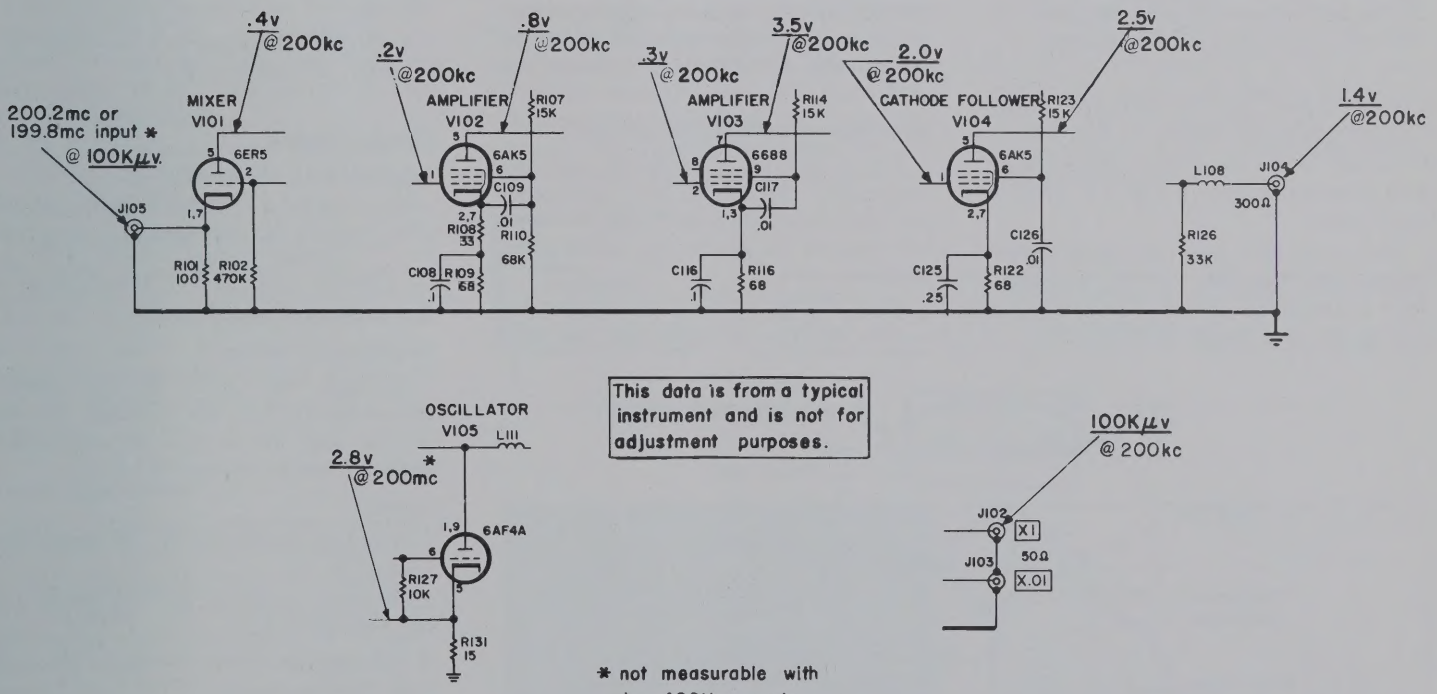


* Not significant.

Varies with control setting.

Voltages are dc unless otherwise specified.

Voltage and Resistance Chart



Signal Tracing Chart

3. Remove adhesive trim strips from right and left side frames to expose three flathead screws. Remove these screws.

4. Remove right side frame complete by removing all screws, including screws and nuts attached to the RF chassis support.

5. Remove screws attaching subpanel to left side frame.

6. Disengage front panel and subpanel from left side frame.

7. Remove knob (4A) from shaft.

8. At this point the front panel can be moved away from the subpanel for repairs or replacement of parts.

RF Chassis

1. Remove front panel as shown under Front Panel removal.

2. Remove fiducial and gears attached to the Frequency Increment control.

3. Remove the screws securing the RF chassis to the front panel subpanel.

4. Remove required cables, jacks, and plugs.

NOTE: The following procedure is to be used when replacing the gears during reassembly of RF chassis.

1. Install small gear on shaft and position gear stop pin shown in Fig. 13.

2. Rotate C135 rotor shaft until rotor is in position shown in Fig. 13. (Mid-capacitance)

3. Slide large split gear onto rotor shaft. Rotate the free gear section with respect to the fixed gear section until the springs are just under tension. This is the point of zero load. Then rotate two teeth, in the same direction, to load the gears and clamp to hold in this position.

4. Mesh the pinion gear teeth by sliding the large split gear in place on the rotor shaft. Setscrews should be in approximate position shown in Fig. 13.

5. Assemble subpanel to RF chassis.

6. Install Frequency Increment Dial in place with "O" in mid-position as shown in Fig. 13.

7. Complete the assemby of the 207H.

8. Install knob on shaft. At this point the following conditions should prevail.

A. Frequency Increment Dial on "O".

B. Stop on small gear to be horizontal pointing to right. The stop can be checked by rotating dial to ends to assure equal spacing at each extremity.

C. C135 rotor at mid-capacitance.

ADJUSTMENT AND CALIBRATION

Any tolerances listed in this section are the limits indicated by the Specifications in Section II. Factory adjustments are made to considerably closer tolerances corresponding to standard practice in the industry. Field adjustments to closer than specified tolerances are possible if time and patience are used.

Recommended Equipment List

The following instruments are recommended for use in the adjustment and calibration of the 207H. Pertinent information is given for substitution purposes.

1. BRC 202H or 202J Signal Generator —The 207H is designed for use with either of these instruments so there should be no substitution.

2. -hp- 400H ac VTVM or equivalent.
Range: 1.0 mv to 300 v.
Frequency Range: 10 cps to 4 mc.
Accuracy: ±1% 50 cps to 500 kc.
± 5% 10 cps to 4 mc

3. -hp- 412A dc VTVM or equivalent.
Range: 1 mv to 1000 v (full range not required).
Accuracy: ± 1% full scale.

4. -hp- 5243L Electronic Counter or equivalent.
Frequency Range: 0 cps to 20 mc.

5. -hp- 5253A Frequency Converter.
Use with-hp-5243L Electronic Counter for the frequency range of 100 mc to 512 mc.

6. -hp- 130C Oscilloscope or equivalent.
Sensitivity: 0.2 mv cm.
Frequency Range: 0 to 500 kc.

7. Sweep Generator.
Capable of sweeping through the range of 142 to 257 mc on a center frequency of 200 mc. with an output signal of 100 Kμv across a 50-ohm load. Flat within ±2% over ±55mc band.

8. Variable Metered Power Source 0—130 vac.
(Model 207HP requires a 0—130v or 0—260v, 50 cps source.)

Power Supply

EQUIPMENT REQUIRED

1. -hp- 400H ac VTVM or equivalent.*
2. -hp- 412A dc VTVM or equivalent.*
3. Variable Metered Power Source.*

B+ SUPPLY CHECK

Preliminary Setup

Connect the 207H to the power source set to 115 vac. Connect the ac VTVM and the dc VTVM across the output filter capacitor (C144A).

Check

1. Reading on the dc VTVM should be 175 ±7v.

2. Reading on the ac VTVM should be less than .006 vac.

3. Change the power source to 95v and note reading on dc VTVM.

4. Change power source to 130 v. Maximum swing of voltage reading should not exceed 5 vdc.

FILAMENT SUPPLY CHECK

With 115 vac input to the 207H, the filament voltage should be 6.3 ±0.3 vac.

*See Recommended Equipment List under Adjustment and Calibration.

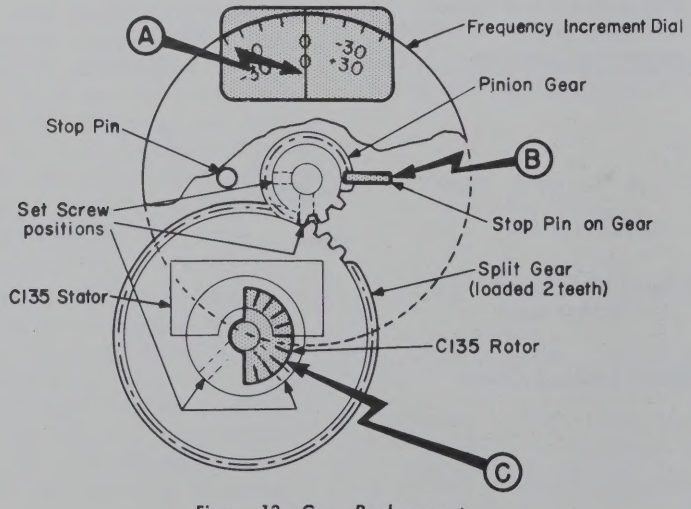


Figure 13. Gear Replacement

Oscillator Frequency Adjustment and Calibration Check

EQUIPMENT REQUIRED

1. 202H or 202J Signal Generator.*
2. -hp- 5243L Electronic Counter or
3. -hp- 5243L Electronic Counter or equivalent.*
4. -hp- 5253A Frequency Converter for above.

PRELIMINARY SETUP

Connect the equipment as shown in Fig. 14. Set 202H/J to 200 mc with 50K μv output using the electronic counter and the attenuator on the signal generator. Adjust C137 for mid-capacitance and C135 (Frequency Increment Dial) to "0".

ADJUSTMENT

Using the ac VTVM as a null indicator, adjust C136 for zero beat at 200 mc to set local oscillator.

CALIBRATION CHECK

The following information is for checking the Frequency Increment Dial calibration. The calibration is adjusted at the factory by bending the slotted rotor plate of C135 at each 100 kc interval. It is not recommended that the rotor plate be adjusted except in the case of replacement.

1. Set the Frequency Increment Dial to +300 kc (black scale). Readjust the 202H/J Signal Generator for zero beat. Frequency counter should change 300 kc ±2% from original reading.
2. Recheck the Frequency Increment Dial (4) at 100-kc increments to —300 kc (black scale). All calibration points should be within 2% except "0" which can be adjusted exactly as under "Adjustment."

Gain Adjustment

See Operating Instructions—Section III—Front Panel Gain Adjustment.

The gain control (R117) is normally not adjusted and remains locked in approximately mid-position. To check maximum gain of the 207H, both R117 and R128 (GAIN) potentiometers may be shorted with a clip lead. The signal generator attached to the 207H should be set for 100 kc difference frequency (207H output frequency) and 100K μv output. The 207H output voltage at the X1 (Unity Gain) output jack should be between 130K μv and 180 K μv for a normal instrument. After checking, adjust R128 (GAIN) as per instructions under Front Panel Gain Adjustment—Section III, if required.

*See Recommended Equipment List under Adjustment and Calibration.

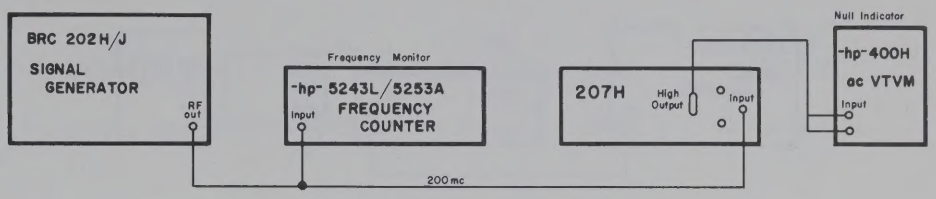


Figure 14. Oscillator Frequency Adjustment

Bandpass Adjustment

EQUIPMENT REQUIRED

1. Sweep Generator.*
2. -hp- 130C Oscilloscope or equivalent.*
3. -hp- 400H ac VTVM or equivalent.*
4. Crystal Detector capable of operating in the 0 to 55 mc range.
5. 50-ohm load.

PRELIMINARY SETUP

Connect the equipment as shown in Fig. 15. Make sure the covers are on the RF chassis and attenuator network. The top cover should be removed from the 207H as all adjustments are made at the top of the RF chassis. The sweep generator should sweep 115 mc (approximately) with a center frequency of 200 mc. The input signal to the 207H should be approximately 100K μv.

The oscilloscope gain is adjusted so as to make 1 cm (vertical) on the oscilloscope grid represent 1 db. The oscilloscope calibration is done by first adjusting the sweep generator for reduced sweep width of less than 1 mc and a center frequency eliminating the 200 mc zero beat. Next, the ac VTVM is connected to the oscilloscope vertical terminals. The sweep generator output control and the oscilloscope vertical gain are alternately adjusted to give the required calibration as indicated by the ac VTVM.

ADJUSTMENT

1. Fig. 16 shows the overall response courve of the 207H as displayed on an oscilloscope. The trimmers listed below are used to flatten out the response curve. Adjustments are to be a compromise to obtain the flattest overall response. The listing shows the trimmer and the area of the curve affected by that trimmer.

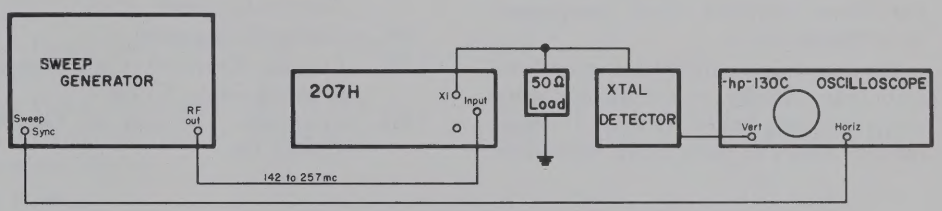
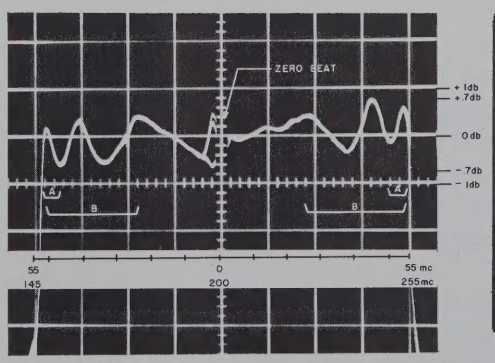


Figure 15. Bandpass Adjustment



Trimmer	*Affected Frequency Range*
C104	A
C106	B
C107	B
C112	A
C114	B
C115	B
C120	A
C123	B
C124	B

NOTE: The sides of the response curve are not exactly symmetrical. This is normal.

Figure 16. 207H Bandpass

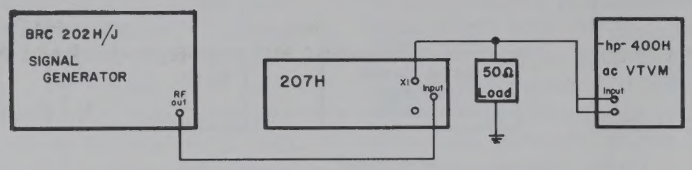


Figure 17. Low Frequency Bandpass Check

2. Change output connection and load from the XI output jack to the uncalibrated output jack using a 300-ohm load. Using Fig. 16 (207H Bandpass), adjust C129 and C131 to the limits specified in Section II for the X1 output jack.

Low Frequency Bandpass Check

EQUIPMENT REQUIRED

1. 202H or 202J Signal Generator.*
2. -hp-400H ac VTVM or equivalent.*
3. 50-ohm load.

PRELIMINARY SETUP

Connect the equipment as shown in Fig. 17. Set the signal generator output to 100K μv.

CHECK

Vary the signal generator frequency through the following ranges while observing ac VTVM:

1. 198 to 199.9 mc.
2. 200.1 to 202 mc.

Frequency response, as indicated by the ac VTVM, should be flat within 8%.

SECTION VII
REPLACEMENT PARTS

Tables of replaceable electrical and mechanical parts for the 207H are included in this section. Locations of these parts are given in Fig. 18 through 21, inclusive. When ordering replacement parts, specify the BRC part number and the description given in the replacement parts tables. See SECTION VI—MAINTENANCE for detailed disassembly and assembly procedures and for the adjustment and/or calibration procedures required after component replacement.

For convenience in obtaining replacement parts locally, a list of manufacturers is shown below. This list is keyed into the tables of parts along with manufacturer's type numbers. When this code and type number is not shown, the part is special, made by or for BRC.

LIST OF MANUFACTURERS

Abbrev.	Manufacturer's Name
AB	Allen-Bradley Company
AEC	Acme Electric Corporation
AER	Aerovox Corporation
AH	Arrow-Hart and Hegeman Electric Company
ASC	Astron Corporation
CEC	Corning Electronic Components, Corning Glass Works
CRL	Centralab, Division of Globe-Union, Inc.
DEC	Dage Electric Company, Inc.
EFJ	E. F. Johnson Company
ERC	Erie Resistor Corporation
FTC	Freed Transformer Company
GE	General Electric Company
HBJ	Howard B. Jones Company
HP	Hewlett-Packard Company
JMM	J. Millen Manufacturing Company
LE	Lectrohm, Inc.
LTF	Littelfuse, Inc.
PRM	P. R. Mallory and Company
SPR	Sprague Electric Company
TI	Texas Instruments, Inc.
TMC	Tower Manufacturing Corporation

TABLE OF REPLACEABLE ELECTRICAL PARTS

CIRCUIT SYMBOL	VALUE	DESCRIPTION	BRC PART NO.	MFG.	MFG'S. PART NO.
C101	.001μf	Capacitor: Fixed, Cer. Disc. GMV, 600WVDC.	82306	CRL	BB-60-102-NZ5Z
C103	.02μf	Capacitor: Fixed, Cer. Disc, GMV, 600WVDC	83118	ERC	ED-.02
C104	.5-3.0pf	Capacitor: Variable, Glass Tubular	84088	CEC	680073 or 680079
C105	.001μf	Same as C101			
C106	.5-3.0pf	Same as C104			
C107	.5-3.0pf	Same as C104			
C108	.1μf	Capacitor: Fixed, Paper, +30% —20%, 200WVDC	83019	ASC	ML-2-1

CIRCUIT SYMBOL	VALUE	DESCRIPTION	BRC PART NO.	MFG.	MFG'S. PART NO.
C109	.01μf	Capacitor: Fixed, Cer. Disc, +80% —20%, 600WVDC	82428	CRL	DAO-48-0034
C111	.02μf	Same as C103			
C112	1-8pf	Capacitor: Variable, Glass Tubular	84089	CEC	680071 or 680079
C113	.001μf	Same as C101			
C114	1-8pf	Same as C112			
C115	.5-3.0pf	Same as C104			
C116	.1μf	Same as C108			
C117	.01μf	Same as C109			
C119	.02μf	Same as C103			
C120	.5-3.0pf	Same as C104			
C122	.001μf	Same as C101			
C123	.5-3.0pf	Same as C104			
C124	.5-3.0pf	Same as C104			
C125	.25μf	Capacitor: Fixed, Paper, +30% —20%, 200WVDC	83023	ASC	ML-2-25
C126	.01μf	Same as C109			
C128	.02μf	Same as C103			
C129	1-8pf	Same as C112			
C130	.001μf	Same as C101			
C131	1-8pf	Same as C112			
C132,133	10pf	Capacitor: Fixed ±2%, NPO, 500 WVDC	82011	AER	CN-1
C134	7.7pf	Capacitor: Fixed ±2%, NPO, 500 WVDC	82042	AER	CN-1
C135		Capacitor: Variable	300280		
C136	.5-3.0pf	Same as C104			
C137A,B	1.5-3.1pf	Capacitor: Variable, Butterfly	84087	EFJ	3MB11
C138	10pf	Capacitor: Fixed, Cer., ±2-1/2%, N330, 600 WVDC	147351	ERC	TC3-10
C139-143	.001μf	Capacitor: Fixed, Cer., GMV, 500 WVDC, Feed-through	82300	AB	FA5C-102W
C144A,B	40-40μf	Capacitor: Fixed, Electrolytic, 200 WVDC	83094	SPR	ELS-9
C145A,B	40-40μf	Capacitor: Fixed, Electrolytic, 200 WVDC with insulating sleeve	83093	SPR	ELS-9
C146A,B	40-40μf	Same as C144			
C147	.001μf	Same as C101			
C148,149	47pf	Capacitor: Fixed, ±10%, 600 WVDC	82115	CRL	TCZ-47
CR101,102		Rectifier, Selenium	300316		
DS101		Lamp, Incandescent: 6.3v, .15amp, 2-pin	90910	GE	#12
F101		Fuse: 1.5 amp., 115 volt operation	93250	LTF	312.015
		Fuse: .75 amp., 230 volt operation	95010	LTF	312.750
I 101		See DS101			
J101		Connector, Socket: 8-contact, female	303079	HBJ	S-308-AB
J102,103		Connector: BNC	307816	DEC	2230-1
J104		Socket: High Output	300286		
J105		Same as J102			
J106		Socket: 3-pin, male	308087	TMC	H-1061-1G
L101	1.06μh	Choke, RF, ±3%	300326		
L102	2.9μh	Choke, RF, ±3%	300325		
L103	.61μh	Choke, RF, ±3%	300323		

CIRCUIT SYMBOL	VALUE	DESCRIPTION	BRC PART NO.	MFG.	MFG'S. PART NO.
L104	1.71μh	Choke, RF, ±3%	300322		
L105	1.06μh	Same as L101			
L106	2.9μh	Same as L102			
L107	.61μh	Same as L103			
L108	1.71μh	Same as L104			
L109		Coil, RF,	85548		
L111	5μh	Choke, RF, ±5%	300327		
L112,113	5h	Choke, Filter: 5h at 75 ma, 200Ω dc	85412	FTC	F24913
P101		Connector, Plug: 8-contact male	89145	HBJ	P-308-CCT-63A-AB
P104		Plug, High Output	300285	JMM	K-37412
R101	100Ω	Resistor: Fixed, ±5%, 1/2 w	80062	AB	EB
R102	470KΩ	Resistor: Fixed, ±5%, 1/2 w	80640	AB	EB
R104	22KΩ	Resistor: Fixed, ±5%, 1/2 w	80404	AB	GB
R105	510Ω	Resistor: Fixed, ±5%, 1/2 w	80129	AB	EB
R106	100KΩ	Resistor: Fixed, ±5%, 1/2 w	80517	AB	EB
R107	15KΩ	Resistor: Fixed, ±5%, 1/2 w	80336	AB	EB
R108	33Ω	Resistor: Fixed, ±5%, 1/2 w	80032	AB	EB
R109	68Ω	Resistor: Fixed, ±5%, 1/2 w	80057	AB	EB
R110	68KΩ	Resistor: Fixed, ±5%, 1/2 w	80549	AB	EB
R111	1KΩ	Resistor: Fixed, ±5%, 1/2 w	80148	AB	EB
R112	330Ω	Resistor: Fixed, ±5%, 1/2 w	80108	AB	EB
R113	100KΩ	Same as R106			
R114	15KΩ	Same as R107			
R116	68Ω	Same as R116			
R117	400Ω	Resistor: Variable, ±10%, 2 w, WW	81034		
R119	1KΩ	Same as R111			
R120	510Ω	Same as R105			
R121	100KΩ	Same as R106			
R122	68Ω	Same as R116			
R123	15KΩ	Same as R107			
R124	1KΩ	Same as R111			
R125	330Ω	Same as R112			
R126	33KΩ	Resistor: Fixed, ±5%, 1/2 w	80461	AB	EB
R127	10KΩ	Resistor: Fixed, ±5%, 1/2 w	80361	AB	EB
R128	1KΩ	Resistor: Variable, ±10%, 2 w	81140	AB	J
R129	150Ω	Resistor: Fixed, ±5%, 20 w, WW	80090	LE	2R
R130	3.3KΩ	Resistor: Fixed, ±5%, 1 w	80259	AB	EB
R131	15Ω	Resistor: Fixed, ±5%, 1/2 w	80011	AB	EB
R132,133	10Ω	Resistor: Fixed, ±1%, 1/2 w, Carbon Film	131501	TI	CD1/2MR
R134	110Ω	Resistor: Fixed, ±1%, 1/2 w, Carbon Film	131504	TI	CD1/2MR
R135	10Ω	Same as R132			
R136	68.1Ω	Resistor: Fixed, ±1%, 1/2 w, Carbon Film	131503	TI	CD1/2MR
R137	39.2Ω	Resistor: Fixed, ±1%, 1/2 w, Carbon Film	131502	TI	CD1/2MR
R138	10Ω	Same as R132			
S101		Switch, Toggle: ON-OFF	88059	AH	81027CE
S102		Switch, Snap Slide: 4 pole (used on Type 207HP only)	88004	HP	3101-0034

CIRCUIT SYMBOL	VALUE	DESCRIPTION	BRC PART NO.	MFG.	MFG'S. PART NO.
T101		Transformer, Filament	85003	FTC	F218
T102		Voltage Stabilizer: 60 cycles, 50 VA	85028	AEC	T-31370
T103		Voltage Stabilizer: 50 cycles, 50 VA (Used on Type 207HP only)	85053	AEC	T-47017
V101		Tube, Electron: 6ER5			
V102		Tube, Electron: 6AK5			
V103		Tube, Electron: 6688			
V104		Same as V102			
V105		Tube, Electron: 6AF4A			
W101		Power Cord Assembly	308086		

TABLE OF REPLACEABLE MECHANICAL PARTS

BRC PART NO.	DESCRIPTION	QTY. PER UNIT
20241	Wiper, Rotor	1
89142	Lamp Holder Assembly: DS101	1
90701	Clamp, 3/16" diameter	1
90702	Clamp, 1/4" diameter	1
93601	Mount, Electrolytic capacitor: metal	2
93602	Mount, Electrolytic capacitor: phenolic	1
94032	Grommet, Rubber (Power supply chassis)	3
95602	Socket, Electron tube: 9-pin ceramic	1
95605	Socket, Electron tube: 7-pin ceramic	4
112302	Cover, Shield can	1
115004	Gear Assembly: Large split	1
115007	Gear Assembly: Drive	1
300065	Washer, Flat	4
300080	Washer, Spring	2
300081	Ring, Retaining	1
300276	Shield, High Output socket	1
300279	Housing, Rotor shaft	2
300280	Rotor Shaft Assembly (C135)	1
300287	Stator Plate	1
300288	Spacer, Tapped: round	3
300293	Terminal, Insulated: stand-off	4
300331	Terminal, Insulated: stand-off	2
300708	Bracket, Rotor wiper	1
300856	Terminal, Insulated	1
301083	Bracket, Resitor mounting (R129)	2
301840	Cable Termination (Dage #95712)	3
302652-1	Shield, Electron tube: (V102) (V104) (V105)	3
302652-2	Shield, Electron tube: (V101)	1
302652-3	Shield, Electron tube: (V103)	1
306015	Lock, Jones connectors	2
306511	Fuseholder Post (Littelfuse 342.014)	1
306588	Knob	1

BRC PART NO.	DESCRIPTION	QTY. PER UNIT
308124	Foot Assembly	4
308132	Handle Assembly	2
308137-21	Strip, Trim: Adhesive backed	2
305155	Nut, Clip	8
308405	Shaft, Frequency	1
308406	Fiducial	1
308407	Dial Assembly: Frequency Increment	1
308408	Spacer, Tapped	2
308412	Spacer, High Output Socket	1
308515	Spacer, Threaded: External	1
308611	Bushing, Front Panel Trim	2
	Nut, Plain Hex—1/2″-28 x 5/8″ x 1/8″ Brass, Nickel Plated (for 308611 Bushing)	2

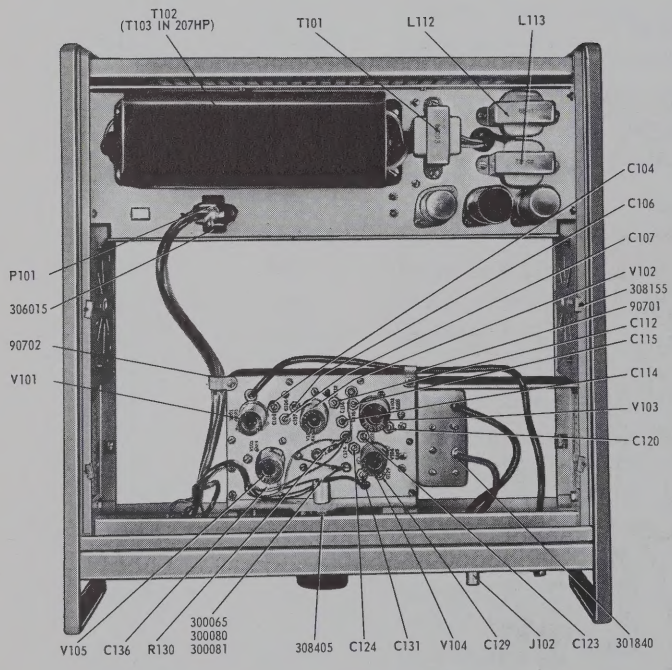


Figure 18. 207H—Top View

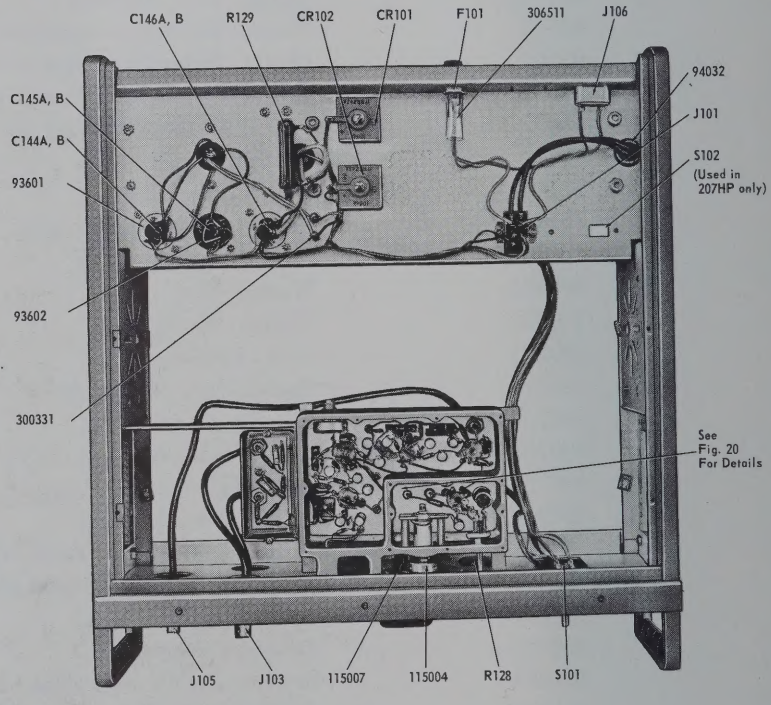


Figure 19. 207H—Bottom View

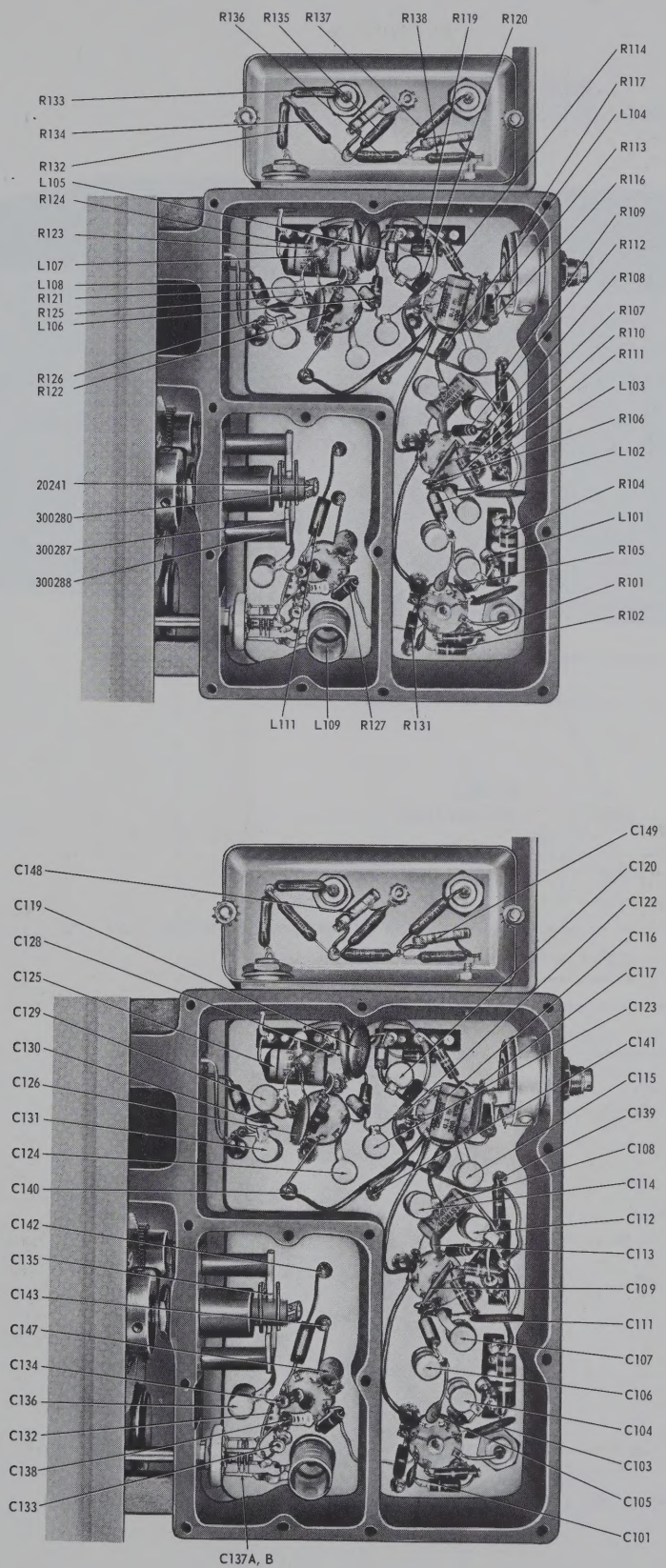


Figure 20. 207H RF Chassis—Bottom View

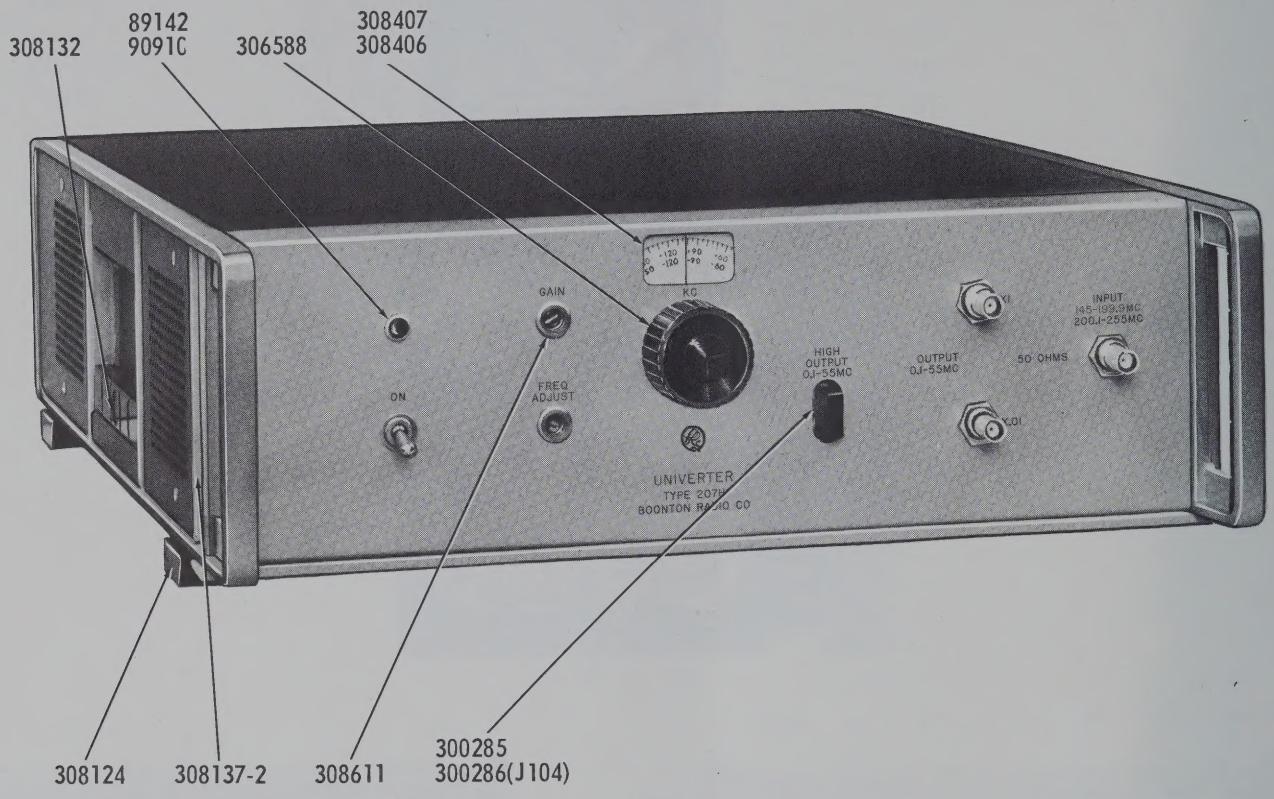
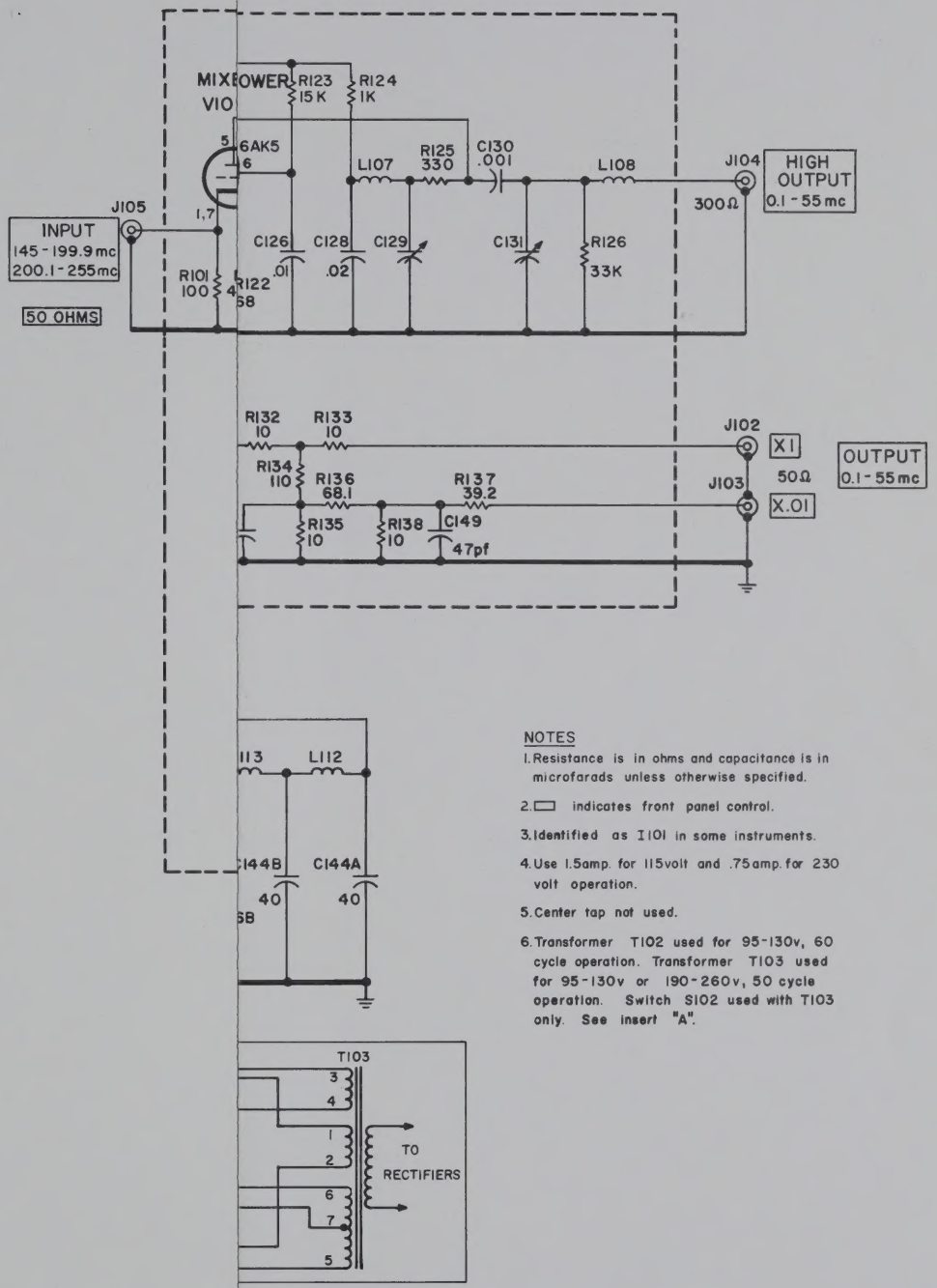


Figure 21. 207H Front Panel Mechanical Parts



NOTES

1. Resistance is in ohms and capacitance is in microfarads unless otherwise specified.
2. ▭ indicates front panel control.
3. Identified as 1101 in some instruments.
4. Use 1.5amp. for 115volt and .75amp. for 230 volt operation.
5. Center tap not used.
6. Transformer T102 used for 95-130v, 60 cycle operation. Transformer T103 used for 95-130v or 190-260v, 50 cycle operation. Switch S102 used with T103 only. See insert "A".

Figure 22. Schematic—207H

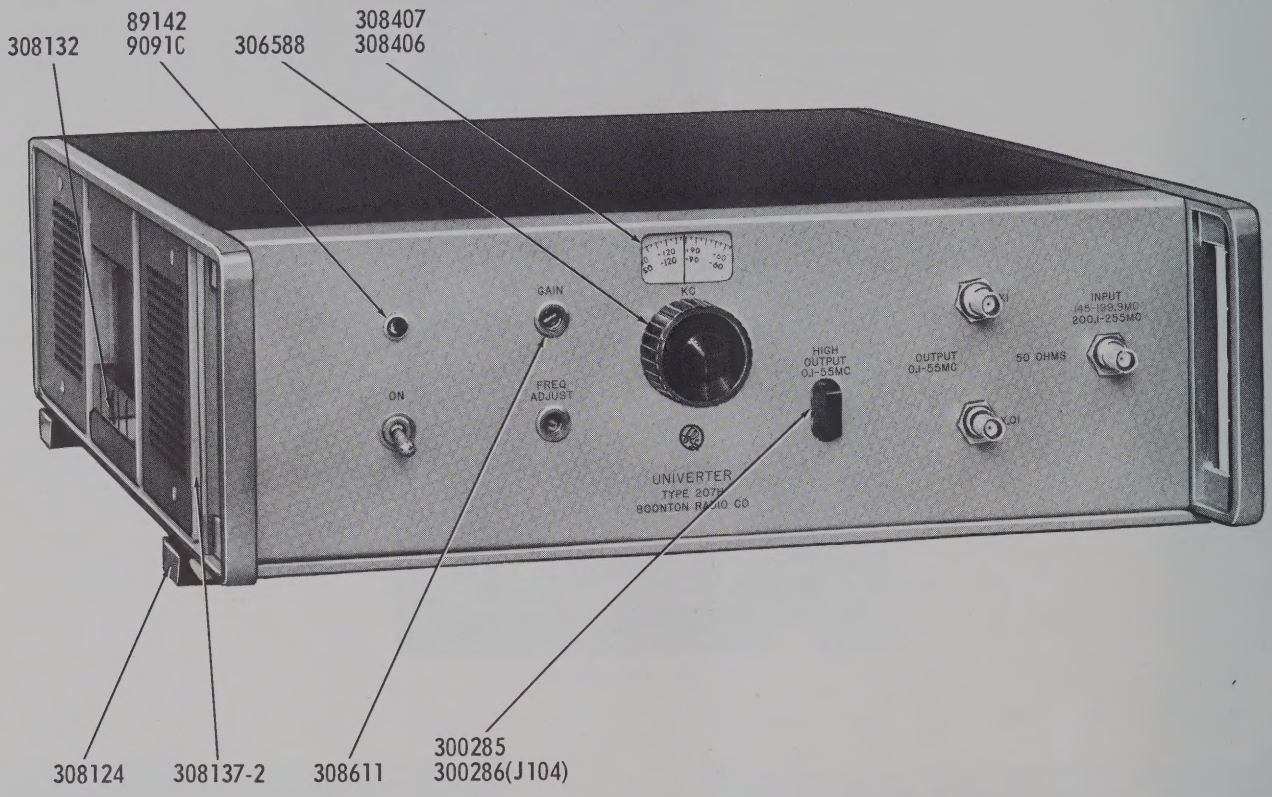
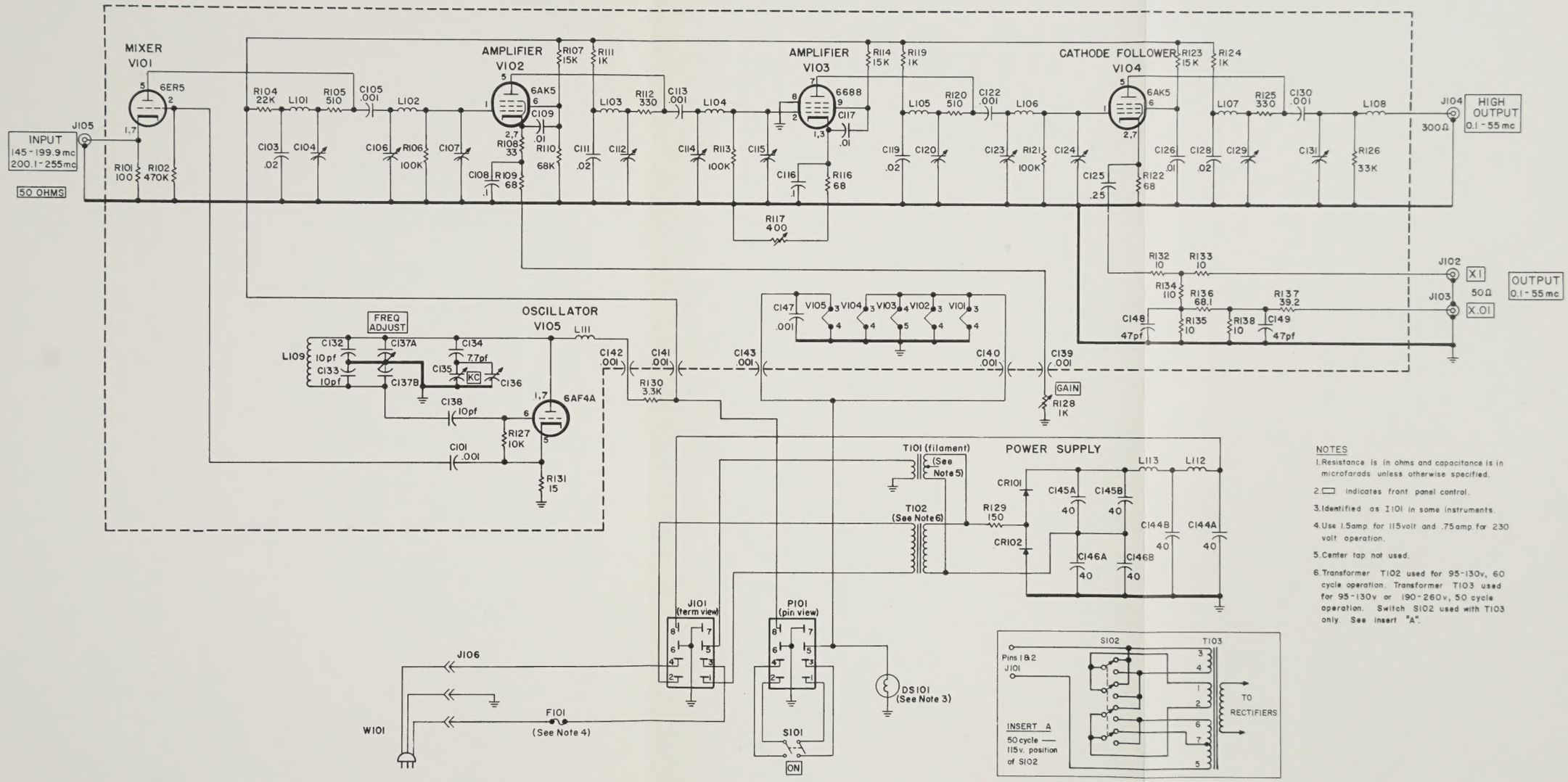


Figure 21. 207H Front Panel Mechanical Parts



NOTES

1. Resistance is in ohms and capacitance is in microfarads unless otherwise specified.
2. ▭ indicates front panel control.
3. Identified as I101 in some instruments.
4. Use 1.5amp for 115volt and .75amp for 230 volt operation.
5. Center tap not used.
6. Transformer T102 used for 95-130v, 60 cycle operation. Transformer T103 used for 95-130v or 190-260v, 50 cycle operation. Switch S102 used with T103 only. See insert "A".

Figure 22. Schematic—207H